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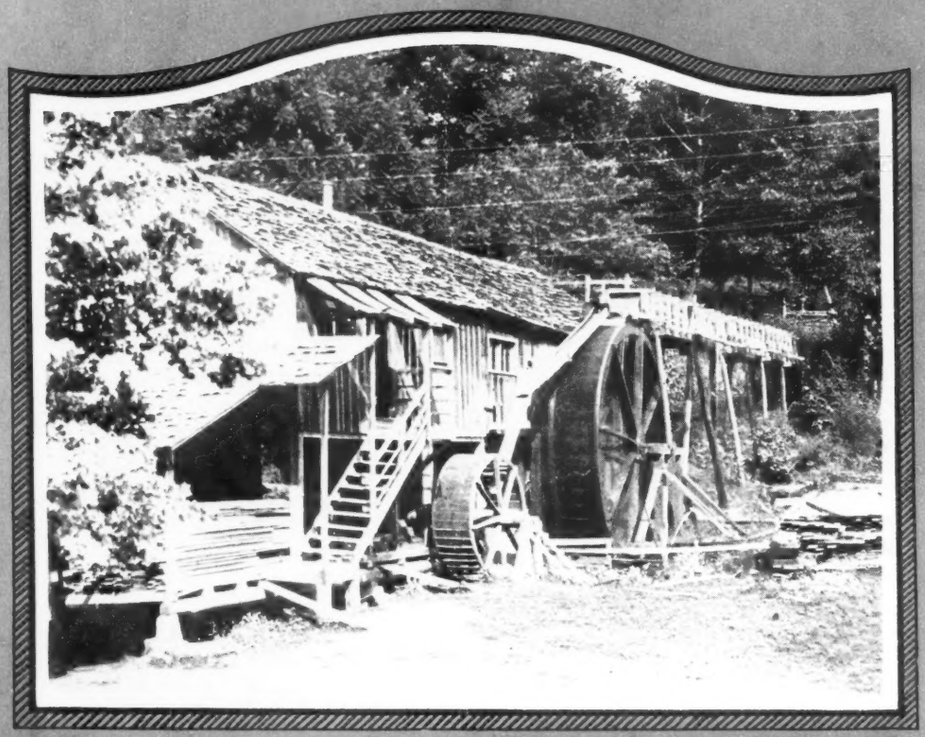

Ewing Galloway, N. Y.

WATER WHEELS LIKE THIS OLD ONE SERVED THE NATION WELL BEFORE HYDRO-ELECTRIC STATIONS WERE BUILT TO PROVIDE US WITH POWER

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I-R Drills are used in every country of the world

You can secure complete machines, spare parts, and service from Branch Offices and distributors located in principal cities of the world

"JACKHAMER"

The "Jackhamer" played an important part in the Otaki Tunnel in Japan.

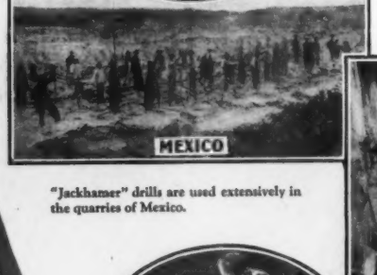
Special footplates are attached to the drills at the Brakpan Mines in South Africa.

Native operator with his drill in the iron mine of Mokta-el-Hadid in Algeria.

Woman operating a "Jackhamer" drill on a dock construction job at Hong Kong, China.

Two "Jackhamer" drills on a large excavation job in Montreal, Canada.

A battery of "Jackhamer" drills putting down 27 holes in a limestone quarry.



"Jackhamer" drills are used extensively in the quarries of Mexico.

Taking out slate is one of the many uses of "Jackhamer" drills in England.

Natives breaking out concrete foundation at Port Said, Egypt.

Ingersoll-Rand

R 1976

As It Seems To Us

ANOTHER USEFUL PRODUCT FROM PETROLEUM

THANKS to the widening use and to the improvements in cracking processes, petroleum is being made to surrender more and more of its valuable constituents. Similarly, by skillful economies practiced in up-to-date oil refineries, wastage in the course of treatment is being steadily reduced. As a consequence, each gallon of petroleum so handled is yielding a higher monetary return.

Until comparatively recently, the butane and propane constituents of gasoline were for the most part permitted to escape at one or more stages in the handling of the gasoline—allowed to vaporize into the surrounding atmosphere. Just what this loss has meant can be appreciated in part when we are reminded that every cubic foot of butane or propane contains approximately 2,800 B.T.U's—more than five times the heat units carried by a cubic foot of manufactured gas such as is commonly used in the home.

In the process of making gasoline, the pressures required in cracking are high enough to liquefy the butane and the propane, which at normal atmospheric pressure and temperatures would promptly vaporize. It has been proved that the gases in a liquefied state can be safely stored in tank cars, tank trucks, or moderate-sized steel containers at a pressure of 100 pounds. Each gallon of the liquid will provide 48 cubic feet of gas of the heating value already mentioned: and, therefore, it is possible to deliver gas for household use to homes and to communities remote from the usual systems of pipe distribution. A suburban or rural consumer may in this way be supplied with sufficient gas to meet his needs for a month running. A tankful of the liquid will gasify itself to the last drop. Thus a loss has been turned into a source of gain, and the public becomes the beneficiary.

JAPAN REJOICES IN HER RESTORED CAPITAL

ALL the world joins in congratulating Japan upon her rehabilitation of the capital city of Tokyo after nearly seven years of strenuous work to obliterate the havoc caused by a succession of seismic shocks and the devastating sweep of attendant flames. What the Japanese have accomplished since the disaster of September, 1923, is splendid evidence of the courage, the virility, and the resourcefulness of the people of that country.

It should be recalled that even while the city rocked and fires raged, an Imperial Rescript was issued that proclaimed that Tokyo would still hold her proud position as the capital of the Empire and that the city would be rehabilitated and made even greater and finer than at any time before the catastrophe. That was heartening so far as it went; but the authorities had a staggering problem in taking care of the survivors and in maintaining law and order amidst the confusion following the widespread loss of life and the unhoming of thousands of people.

Today, Tokyo smiles triumphantly in her new-born dignity—a marvel of skillful and tireless coördination of efforts. Some weeks ago the Emperor of Japan made a ceremonial survey of Tokyo to commemorate the city's recovery and what has been done towards making her worthy of her national position. It is a source of felicitation to Americans that they were able to lend a sympathetic helping hand to the Japanese during the period of their most intense distress; and that, later, we supplied them to a considerable extent with tools and other mechanical equipment essential in bringing about the rehabilitation which has recently been celebrated. Of course, much still remains to be done in extending, developing, and improving Tokyo in the way planned after the earthquake.

SHOWING ONE'S WARES TO THE WORLD

LEIPZIG annually features a technical fair which, year by year, demonstrates its material value, especially to the German exhibitors. Carefully tabulated statistics reveal that there is a direct connection between the attendance of foreigners and the volume and value of German exports to the countries so represented. In fact, the parallelism between the number of visitors from abroad and the value of goods exported is striking.

The *Engineer*, of London, makes this significant editorial comment: "The expense of such an annual show must be very great, for the transport across Germany and back of some of the largest tools ever built, and their erection, operation, and dismantling, cannot be done for nothing. One firm alone brought over 133 tons of machinery from Düsseldorf. The cumulative effect on foreign business of such shows is, however, unquestionable. Returning from the British Industries Fair, where not a machine tool is to be seen, and observing the annual display at Leipzig, they are not to be blamed if they consider the British tool-making industry as negligible in comparison with that of Germany. Though we are really far from that point, it can hardly be comforting to our own manufacturers to reflect that during the last three years the value of machine tools exported by Germany has been very nearly four times the value of British tools exported. Indeed, the whole of the British tool exports during 1929 had a value only fractionally greater than that of the increase alone in the German exports during the same year . . Whatever the enterprise may cost, the expense would seem to have justified itself."

It should be manifest to all other countries engaged in similar lines of production—especially when seeking to widen recognition in the markets of the world—to ponder what the Germans have manifestly achieved through the annual display of their wares at the Leipzig Technical Fair. In all departments of life today the desire is to save time in mastering any subject; and an engineer or plant manager can get in a few seconds or in a few minutes, at the most, an essential understanding of a machine that might require an hour or more of careful reading of a catalogue. And the effectiveness of such a display is enormously enhanced when the machines are set up so that they can operate. This is merely one more verification of the old saw, "seeing is believing".

MISERY A MOTIVE FOR BETTER WORK

WE have it on the authority of a psychologist, identified with an American university, that the unhappily married man is usually more efficient than the happily married man. By way of explanation it is said that the man beset with marital miseries applies himself more intently to his business than does his fellow who is generally considered more fortunate in his domestic relations. Such a conclusion is not likely to receive universal approval; and it is a safe bet that a great many persons will take an emphatically opposite stand.

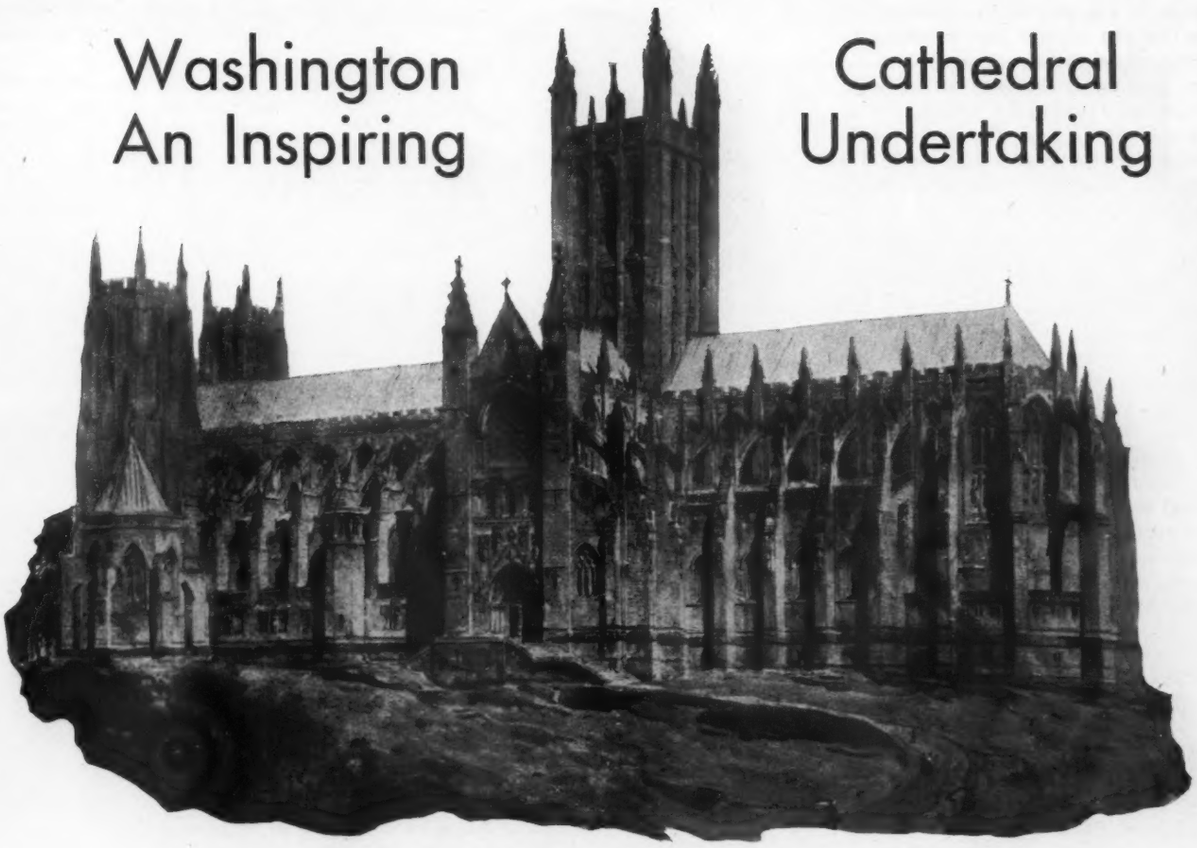
It is well within the memory of most of us that a dog with a can tied to its tail is apt to kick up considerable dust as he hastens along the road; but his speed is not due to absorption in some particular canine problem foreign to the immediate contact with the aforesaid can. No one has yet convinced us that we can get better service out of our cars by putting sand in the gear box; and we have not yet reached that stage of gullibility that makes us accept the theory that only the happily absorbed star gazer is the one that walks off a dockhead and into the next world.

Admitting that the psychologist makes a fairly close guess of the meaning of our mental processes at times, we are equally satisfied that he overreaches himself on occasions when he wishes to win publicity and to make himself out something of a wizard. Nevertheless, our experience is that no person with worries can ever give of his mental best if those worries are very much with him, as, for example, the can tied to the dog already referred to. A good many of us will do finer and better work against odds, no doubt; but those odds are usually of a sort that stimulate the best that is in us—they are the hammer blows that forge character from more or less raw material.

View of the completed apse of the Washington Cathedral when illuminated after nightfall.

Compressed Air Magazine, May, 1930

Washington Cathedral An Inspiring Undertaking



Washington Cathedral as it will appear when completed. The central tower will rise to a height of 262 feet above the ground.

R. G. SKERRETT

WORK on Washington Cathedral goes steadily forward at the National Capital. Month by month the beautiful structure grows—indicating by just so much what the ultimate magnificence of the edifice will be when the contributing artisans lay down their tools and stand back to look upon the culmination of their years of collaboration.

Even in its present far from complete state, Washington Cathedral stands forth impressively on the crest of Mount St. Alban, to the north and west of the communal center of the National Capital. And when finished, the towering central spire of the Cathedral will overtop the Washington Monument by more than 100 feet. When ready for the service to which it is dedicated, Washington Cathedral will in a measurable degree give material form to an idea entertained by Major L'Enfant when he prepared the plans for America's "Federal City".

As will be recalled, L'Enfant provided, among other things, for a "church for national purposes". But such could not be in a country founded by pioneers seeking the utmost in religious liberty. Washington Cathedral, therefore, while not allied with the State, is nevertheless intended to express what God has meant and means to the people as a whole, without thought of denominational emphasis. In fact, persons of many creeds, and both in this country and abroad, have contributed to the undertaking, conscious that the project has been conceived in the broadest acceptation of the term Christian fellowship. The work has been going forward for years, under Protestant Episcopal control—a communion with an inherited cathedral tradition; and the present aim is to advance the structure far enough so that it will be possible to hold religious service in it two years hence to commemorate the two-hundredth anniversary of the birth of George Washington.

The religious significance of the cathedral dates back to the very early days of missionary bishops who followed immediately in the footsteps of the apostles; and from that day to this it has represented a focal center of worship, evangelization, and social service. Because of its commanding size and majestic beauty, but mainly by reason of its far-flung influence as a unifier and conserver of the spiritual ideals of nations, the cathedral has always been an agency in promoting patriotism. To the cathedral Christian peoples have unfailingly turned in times of national crises or on occasions of national thanksgiving; and the cathedral has often been deemed the most befitting place for the sepulture of a nation's illustrious dead. So much for some of the reasons for Washington Cathedral in the National Capital.

It is not necessary here to detail the part played by cathedrals in the past in welding antagonistic peoples into single nations through the influence of a common religious urge; nor need we point out how some of the greatest educational institutions in the world have been the outgrowth of schools and universities that had their start and developed under the guidance of cathedrals exercising nation-wide and, later on, international influence for the good of all.

Washington Cathedral is only one among a number now in course of construction in the United States; and this trend in ecclesiastical architecture is but another example of how history repeats itself. The building of cathedrals, so we find, reached a climax of enthusiasm in France where, beginning about 1150, something like eighty Gothic cathedrals were erected. Catherine Boyle O'Reilly, in her book, *How France Built Her Cathedrals*, has thus summed up the spirit of that movement: "Never was aspiration toward the Infinite more passionate . . . . Serf, artisan, burgher, baron and king built the Cathedrals; field laborer, minstrel, maiden and chatelaine were harnessed to the same cart to drag the stones. Little children cleared the church pavement of sand and cement in preparation for the 'Day of Benediction' for their city, as the solemn blessing of their church was held to be by these God-fearing generations."

There is reason to believe that just as governmental centralization has become more pronounced in order to meet the needs of a stronger and more unified nation, so it has become apparent that something should be

undertaken on a large scale in a spiritual way in order that the country may maintain and strengthen its religious ideals. Because, as the Old Testament expresses it: "Where there is no vision, the people perish".

So rapid has been the march of science, engineering, and the means of transportation and communication in the past half century and less that our whole order of life has changed profoundly, bringing in its train problems of many sorts. Instead of being principally a country of a pioneer, rural, and agricultural nature, as was the United States 50 or 75 years ago, and made up of many scattered communities—self-contained and amply able each to deal adequately with its own problems, present-day America is in the main urban and industrial in character. In addition to this great change, an influx of peoples unfamiliar with our spiritual traditions has created conditions undreamed of generations ago—conditions that call for new ways of dealing with them. Therefore, just as the Government is meeting these new conditions through the establishment of great centralized administrative agencies—housed in a dignified and befitting manner—so religious leaders, facing kindred problems, are turning again to an institution that has proved effective in the ages gone in unifying and strengthening the spiritual aims of the people. Hence, America is now building her cathedrals where they may be of the greatest service to her own people and to those that come to her shores for any purpose. Washington, because of her unique position in our national life and because of her world-wide influence, is logically the place for a great cathedral.

The first definite steps towards the present Washington Cathedral project were taken in 1891; and two years later, on January 6, Congress granted a charter to the Protestant Episcopal Cathedral Foundation of the District of Columbia, empowering it to establish

The eastern section of the Washington Cathedral, which constitutes the apse and the choir.

a cathedral and institutions of learning "for the promotion of religion and education and charity". The site for the Cathedral Close was wisely chosen on the wooded slope of Mount St. Alban, where already stood old St. Alban's Church. By judicious purchases, the original holdings have been increased until they cover an expanse of 67½ acres, that overlook the City of Washington and the broad sweep of the Potomac River.

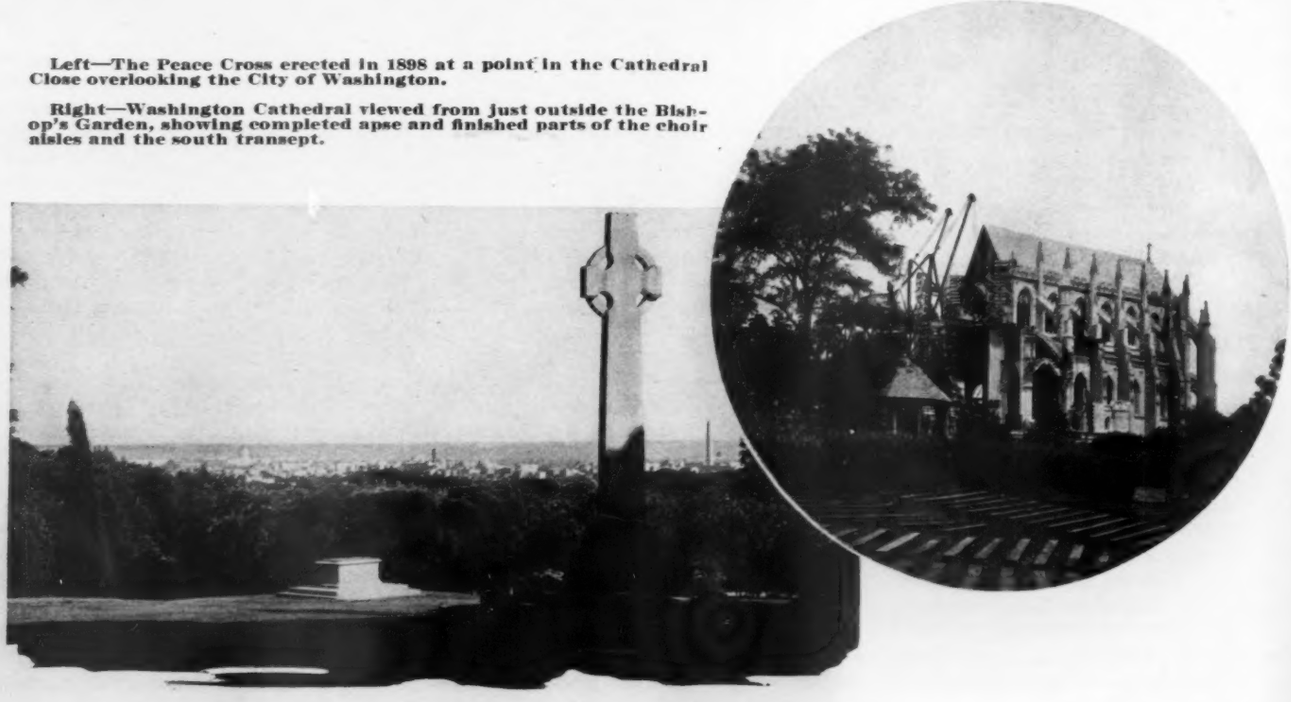
The plans for the Washington Cathedral were prepared by Henry Vaughan and Dr. George F. Bodley, both now deceased; and the plans were accepted in 1907—the year when the foundation stone was laid. Since the original designers died the work has been carried forward by Messrs. Frohman, Robb, and Little as architects, with Messrs. Cram and Ferguson as consulting architects. Besides the great Cathedral, itself, the project in its entirety will embrace about 30 auxiliary buildings, all of which are deemed essential to the complete program of far-reaching cathedral service.

The purpose of the architects has been to produce a cathedral that would typify the purest form of Gothic architecture, that of the fourteenth century. That period of Gothic art is admittedly the most beautiful, the most expressive, and the most distinctively Christian that the world has ever seen. Such being the intent of the designers, Washington Cathedral will stand apart in its newness, and will in no wise constitute a copy of any foreign cathedral. In its general type, its proportions, and its system of construction, the Washington Cathedral, so it is said, will be more like a medieval cathedral than any other great church so far undertaken in this country. Accordingly, any one visiting the Cathedral will be able to see how some of the cathedrals of the Middle Ages must have appeared when in course of construction. Something like 600 years have elapsed since comparable work has been in hand on an ecclesiastical structure.

Perpetuating an ancient custom, the ground plan of the Cathedral is in the form of a cross—the arms of the transepts extending north and south. The total length of the building, from the exterior of the apse at the eastern end to the main entrance at the western end, will be 534 feet. The total spread of the transepts will be 215 feet, and each of these arms of the cross will be 105 feet wide. The ground area will be 71,000 square feet, and this will be ample to provide standing room for 27,000 persons on occasions of special

Left—The Peace Cross erected in 1898 at a point in the Cathedral Close overlooking the City of Washington.

Right—Washington Cathedral viewed from just outside the Bishop's Garden, showing completed apse and finished parts of the choir aisles and the south transept.



Various activities within the stone-cutting plant of the George A. Fuller Company. 1—Gang saws cutting slabs from a large block of Indiana limestone. 2—Planer truing blocks of Indiana limestone for use in the Washington Cathedral. 3—A diamond saw cutting limestone with astonishing ease. 4—Wire saw being used to cut a large block of Indiana limestone. 5—A skilled stonecutter carving a decorative feature and using an air-driven chisel.

or great services. The central tower will rise to a height of 262 feet; and each of the two western towers will be 195 feet high. The nave will have a span of 40 feet, and its height will be 95 feet. Other impressive figures might be cited, but those already mentioned will suffice to give the reader an idea of the splendid proportions of the structure.

To most of us the term Gothic, when applied to architecture, merely suggests antiquity without making the subject any clearer. The outstanding difference between a cathedral of true Gothic form and churches representing other styles of architecture is that every stone used in a Gothic structure adds both to the weight and to the strength of the building. This distinction applies not only to those features usually regarded as essentially structural but also to those parts of the edifice which are commonly considered to be primarily for ornamental ends. Such being the fact, we of this age and generation must recognize the engineering skill displayed by the architects who produced the original Gothic designs.

It is interesting to recall how the Gothic edifice evolved in principle. In the Middle Ages, when masons began erecting churches entirely of stone, it was found that the stone-vaulted ceilings exerted a powerful outward or disruptive thrust against the supporting walls. To neutralize this stress in the most direct and scientific manner, the architects of that time developed a system of external arches—projecting outside the main body of the building, and these arches spring from the clerestory walls to the main sustaining buttresses. Again, to prevent these arches or flying buttresses from overturning the buttresses or moving the upper courses of stone in the buttresses, it was found necessary to weight down the tops of the buttresses by additional stone that was given the form of lofty and graceful pinnacles. These pinnacles represent but one instance among many in which the seemingly ornamental is really a structural necessity cleverly disguised as such.

In pure Gothic architecture, the principle requires that every bit of carved stone shall be either structural or symbolic; and such a structure, because of its conformity to natural laws, expresses in stone the growth and vital characteristics of Nature's works. For example, in a Gothic cathedral we have a combination of strength and simplicity with apparent lightness and grace in its manifold details. To a marked degree it duplicates the essential features of a gigantic tree that has rugged roots which bind it to the soil, an upstanding sturdy trunk, and then a vast array of branches that develop finally into myriads of delicate twigs and leaves. It is not the dead weight of a Gothic cathedral that most impresses one but rather its manifest strength, its beauty of form, and its upward growth as if responding to beneficent influences operating from above.

1—Close-up of foundation work and crypt under construction at the western end of Washington Cathedral.
2—Washington Cathedral as it appeared about ten months ago, viewed from the southwest.
3—Point on the southern side of the Cathedral where the south transept will be erected.

Last fall, Bishop James E. Freeman, the titular head of the Diocese of Washington, laid the first stone in the construction of the north and the south transepts. Upon that occasion, Bishop Freeman said: "This day marks a new and epochal advance in the building of this Cathedral. The present program marks the greatest step we have thus far taken, for in volume and extent it contemplates the carrying forward of the Cathedral to a point where it may be used for worship and where space may be had to accommodate a congregation of approximately 3,500 people." The object is to have this work

These drawings indicate how the Washington Cathedral will appear when completed. Left—Looking westward from the sanctuary toward the main entrance. Center—Cross section of the nave. Right—Interior of the north transept and crossing.

completed during 1932.

Lest the impression be given that the Cathedral is not yet available for services, let it be said that there are in the crypt three chapels. The Bethlehem Chapel—a memorial to the first Bishop of Washington—is the scene of daily services; and the Chapel of the Resurrection and the Chapel of Saint Joseph of Arimathea are likewise completed. Each of these chapels is an architectural masterpiece of a distinctive type; and the Chapel of the Resurrection is believed to be the first of its particular type erected since the eleventh century.

One has only to recall how the ancient cathedrals of Europe were reared to realize that their architectural culmination represented in most instances the labors of several generations. A large percentage of the workers were craftsmen, and they gave of their creative best without regard to the wages or material rewards of the times. Their callings were virtually dedications of their services to the spiritual cause of the structure, and they interwove themselves in the fabric. While Washington Cathedral has gone forward at a much more rapid pace, thanks to the mechanical agencies now available, still a very considerable number of the artisans engaged in the undertaking are giving of themselves as did the men that built in the centuries gone.

As it stands today, Washington Cathedral is relatively little more than a fragment of what it will be in the splendor of its completeness, but even so it draws to it annually visitors and worshipers totaling about 300,000. These come from all parts of the country and even from alien shores. While some go there only to admire; and while others may seek to look upon the last resting places of some of the Nation's illustrious dead; still in all probability but few can depart without a feeling that the structure stands for something infinitely more significant than any memorial to human achievement. It represents what religion has meant to our people since those days when the pioneers ventured into America's wilderness in quest of freedom in the worship of God.

Apart from its exterior beauty, the Washington Cathedral, like other examples of the finest Gothic edifices, will possess an interior impressiveness of an exceptionally high order. It is this effect upon the worshiper and the casual visitor that emphasizes the littleness of man in comparison with the ordered Infinite of which he forms but a momentary material part. Conversely, it provides the inspiration for nobler and more vigorous expression of the finer qualities within him.

Since its inception in 1893, the Cathedral Foundation has received offerings, large and small, from 33,000 persons. More than $6,000,000 had been contributed up to 1928; and of that sum something in excess of $2,000,000 had been expended on the Cathedral fabric. The remaining $4,000,000 is represented by lands, by buildings other than the Cathedral structure, and by endowment and building-fund investments. When the Washington Cathedral's complete program of national service is brought to fulfillment it will represent a matter of approximately $30,000,000.

In the main, the fabric of the Cathedral will be of Indiana limestone. Before deciding upon this material, the architectural authorities had the stone tested by experts of the United States

Looking outward toward the south and west from a point where the south transept will join the main structure. Even this limited picture gives an idea of the architectural beauty of the edifice.

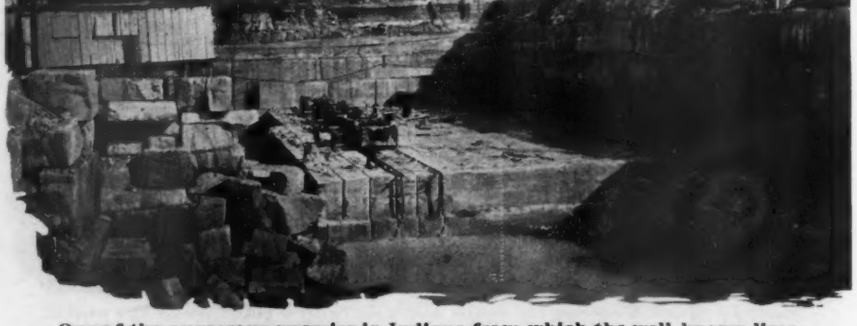
Bureau of Standards. As a result, it was declared that the limestone would be able to withstand atmospheric attack and the effects of seasonal weather changes for a period of substantially 2,000 years. If the Cathedral endure for half that time and serve the purpose for which it is being reared, it will give ample warrant for every penny that shall have been spent upon it. The George A. Fuller Company is building the Cathedral; and to facilitate its operations that concern has called into being at Bethesda, Md., a few miles northward of the Cathedral, a thoroughly up-to-date stone-cutting plant.

This Imperial Type 10 compressor furnishes operating air for the stone-cutting plant of the George A. Fuller Company at Bethesda, Md., where Indiana limestone is being cut and carved for the Washington Cathedral.

The Cathedral Close, because of its wonderful location on the slope of Mount St. Alban, is lending itself notably to the work of the landscape gardener; and already the Bishop's Garden and other sections of the Close have acquired a semblance of centuries of cultivation that gives to the setting great charm. Boxwood growths hundreds of years old have been transplanted from their historic settings, and other shrubs, identified with people and places that figured in the earlier periods of our national evolution, have been moved to the Cathedral Close. Again, from ancient shrines and points intimately identified with our religious and our colonial past, stones have been drawn for use in one way or another in and about the Cathedral.

Among the auxiliary buildings are a school for boys, a school for girls, and what is known as the College of Preachers—the purpose of the latter being to further qualify ordained clergymen who have natural gifts so that they can be made just that much more effective in the pulpit. There will be a number of other structures; and all will contribute to round out the capacity of the Cathedral to do the work for which it has been planned.

Washington Cathedral was conceived, because of its location in the City of Washington, to serve as a central power house of the Spirit, so as to give increased vitality to our national declaration, "In God We Trust". The timeliness of such a service is emphasized when it is recalled that 62,000,000 of our population are unaffiliated with any religious body—a state of affairs radically and disquietingly different from that prevalent when we fought to bring ourselves into being as a nation.



One of the numerous quarries in Indiana from which the well-known limestone is quarried for architectural purposes.

COMPRESSED AIR IN THE ROLE OF LIFE SAVER

HELD in the relentless grip of quicksands at the bottom of a 35-foot well which he had been ordered to clean, John Stanover, an 18-year old negro, was rescued after more than 24 hours of imprisonment by the use of compressed air. This, in a nutshell, is what happened not long ago on a plantation in Cotton Valley, La.; and, according to the reports, the situation looked almost hopeless when some white roustabouts from the local oil field, hearing of the youth's plight, arrived on the scene.

They discouraged any further attempts to drag the unfortunate boy out forcibly by ropes, etc., knowing that the hold of the sand would first have to be broken before he could be released without grave injury to him. Hastening to the nearest town they searched for a compressor and succeeded in finding an old-fashioned machine, complete with receiver and hose, used for inflating tires. This they promptly borrowed and set up at the well, where they were able to introduce into the soil and well below the darky's feet a nozzle made for the occasion from a handy piece of small-diameter pipe. This nozzle was attached to the air line leading back to the receiver.

It was a tense moment when the machine was started. Those watching could see that the compressed air was doing the work expected of it in its effort to escape surfaceward. The sand and water were being agitated by the rising air; and, when a pull was once more exerted on the ropes, fastened to the now thoroughly exhausted youth, it was found to the relief of all that the sand had sufficiently relaxed its hold to permit Stanover's rescue. It is said that he suffered no ill effects as the result of his terrifying experience which, but for the timely and well-directed use of compressed air, would have ended fatally.

CELLULOSE CONTAINERS FOR FOODSTUFFS

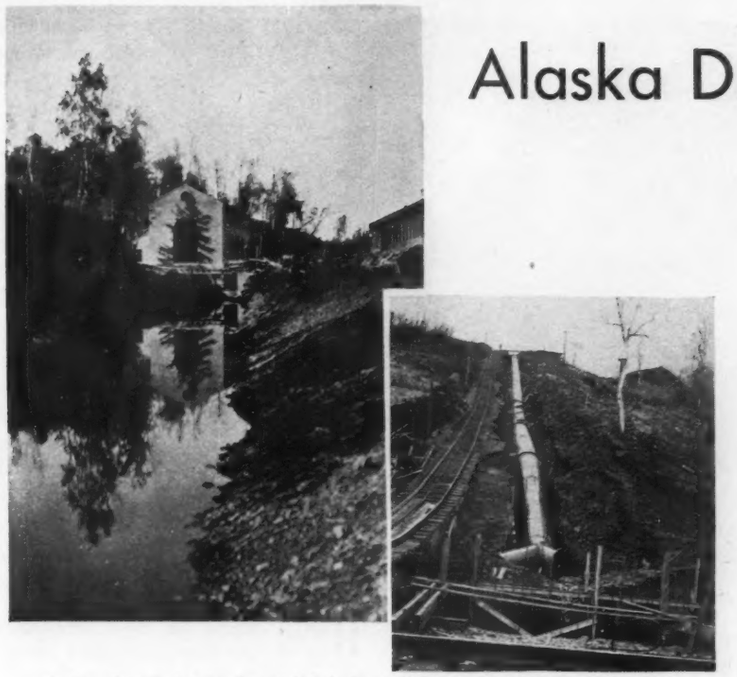
SEVERAL months ago the Eastman Kodak Company announced the discovery in its laboratories of a cellulose substance of such properties as to make it suitable for containers for foodstuffs of all sorts. Since that time exhaustive experiments with the material have been made by the American Can Company which is now ready, so it is reported, to use it on a commercial scale in the production of containers of different shapes and sizes.

Many foodstuffs, both wet and dry, have been put up in these transparent receptacles, which have proved themselves to be non-breakable, non-corrosive, and unaffected by heat, cold, and dampness. The new substance is known as "makelite"; and it has been estimated that approximately 250,000 pounds of it, in sheet form, will be required for can-making in 1930.

Made into mats and used as an insulating material in walls and ceilings, eel grass is said to render buildings substantially sound-proof.

Alaska Draws Power from The Eklutna River

By C. F. LANE



Left—Power house in which is installed the 1,500-hp. horizontal turbine that drives the 1,250-kv-a. generator and exciter. Right—Steel penstock in process of assembly, showing the wye to distribute water to the present power unit and to the second one that will later be placed in the power house.

ALASKA now boasts an active hydro-electric plant located within less than half a hundred miles of the 62nd parallel of latitude. The operating water for this power station of the Northland is drawn from a lake which, in its turn, is fed by inexhaustible glaciers. What would the old sourdoughs of pioneer days think of this innovation and the inevitable industrial developments that it portends? Such is the march of progress and the adaptation of resources hitherto put to little if any service.

The plant referred to is situated near Eklutna, and a trifle more than 26 miles north of the bustling Town of Anchorage. In fact, the Eklutna project is the direct outcome of the organization and the activities of the Anchorage Light & Power Company. In turn, it is the culmination of efforts initiated by Frank I. Reed, who years back happened upon Eklutna Canyon when he was engaged in freighting in that part of the Territory. Mr. Reed realized that Eklutna Canyon was admirably suited for the construction of a dam that could impound the waters of the Eklutna River so as to make them available for the generation of electric energy; but nothing to this end was actually achieved until after the organization of the Anchorage Light & Power Company in 1923. When the day came for providing the necessary funds, residents of Anchorage and the neighborhood came forward handsomely; and the Russell-Colvin Company of San Francisco has figured conspicuously in the financial affairs of the corporation.

A preliminary permit, establishing priority for power purposes, was granted by the Government in March, 1923; and a license to go ahead with the work was issued in the latter part of 1928. Construction was begun on September 16 of that year. On September 9, 1929, current was turned into the line leading from the power house to Anchorage. These dates will become more significant when the work done is described.

The project, aside from the power plant, called for the building of a storage dam at Eklutna Lake; the construction at Eklutna Canyon, nine miles downstream, of a diversion dam; the driving of a 7x8-foot tunnel through the rocky backbone of a hill for a distance of substantially 1,900 feet; and the assembling of a 52-inch steel penstock, 900 feet long, connecting the pressure tunnel with the power house. The power house now contains a single 1,500-hp. horizontal turbine supplied by the Pelton Water Wheel Company; and this prime mover drives a 1,250-kv-a. General Electric generator and exciter. The station is planned to accommodate two such units.

Eklutna Lake was first closed at its lower end by a storage dam, an earth-fill structure 13 feet high and 240 feet in length. That dam serves to raise the level of the lake 5 feet and to impound 16,500 acre-feet of water. Outlet gates and a spillway provide for the escape of 6,000 cubic feet of water per second. The released water flows down the natural channel of the Eklutna River where it is intercepted by a concrete arch dam, 61 feet high and 98 feet long on the crest. The crest coping is made up of heavily reinforced concrete and has a slope for 4½ feet on the upstream face so as to free any ice tending to form there. The spillway crest has a clear waterway 73 feet wide, and it is ample enough to permit the flow of 6,000 cubic feet per second.

At a point 17 feet below the crest of the diversion dam the impounded water enters the pressure tunnel, which has its intake near the north abutment of the dam. This intake, of course, is suitably protected by a trash rack, which also serves to keep out obstructing ice. The pressure tunnel was started on January 1, 1928. According to Mr. Harold I. Wood, resident engineer: "Air for drilling was supplied by a 2-stage Ingersoll-Rand compressor, driven by a 100-hp. electric motor; and two Ingersoll-Rand N-75 drifters were used to drill the rock in the tunnel, which was holed through on June 25, 1929."

The diversion dam on the Eklutna River which turns water into the adjacent intake portal of the 1,900-foot pressure tunnel.

Mr. Wood gives also the following interesting particulars concerning the construction of the diversion dam, which is set securely on solid rock. To quote, "The foundation in the river bed and canyon walls was grouted through drill holes 10 feet deep spaced on 10-foot centers along the upstream face of the dam. Portland-cement grout was used under air pressure of 80 pounds per square inch; and extreme care was exercised to secure a bond between the solid rock and the concrete . . . The upstream face of the dam is waterproofed."

The foundation for the diversion dam was excavated with DCR-23 "Jackhamers" and CC-35 paving breakers—

operating air being supplied by a portable compressor located on the rim of the canyon. Mr. Wood has stated: "The construction of this dam was the most hazardous part of the undertaking. The nearly vertical canyon walls were scaled of loose material, but even with this precaution the frost action loosened rock fragments and menaced the workmen below. The foundation for the diversion dam was prepared after the river flow at Eklutna Lake was shut off. A diversion flume, 260 feet long and with a capacity of 60 second-feet, was built to conduct the water that afterwards came down the valley across the site of the foundation." The steels for all the rock drills were conditioned with a No. 50 sharpener.

Within the power house. The 1,250-kv-a. General Electric generator that furnishes current to the transmission line that links the hydro-electric station with Anchorage.

At the north or discharge portal of the pressure tunnel, where the south end of the steel penstock joins the tunnel, that aqueduct was lined with reinforced concrete applied pneumatically. The connecting link for the 54-inch penstock is a 68-inch steel pipe, 35 feet long, securely anchored within the tunnel portal and provided with a wye that takes care of the existing single penstock and makes provision for a duplicate penstock that will be built when a second water wheel and generator are placed within the power house. The penstock is 900 feet long. The operating head between the diversion dam and the Pelton wheel is 230 feet. An air-driven "Little Tugger" hoist proved very helpful in placing sections of the steel penstock.

Trucks were used to move materials from a siding on the Alaska Railroad to the rim of the canyon just above the diversion dam; but supplies for the camp at Eklutna Lake were transported on pack horses during the fall and on sleds during the winter season. A dog team was employed by the superintendent, Mr. George A. Moland, and the resident engineer in traveling between the camps when snow was on the ground. Steam was utilized to heat the sand, aggregate, and water used in mixing the concrete. This becomes understandable when we are told that the foundation of the diversion dam was poured at a season during which the thermometer ranged from 20° below zero Fahrenheit to 20° above. Even so, the contractor, Jasper-Stacy Company, was able to maintain the concrete at all times at a temperature considerably above 40°.

One might suppose that labor would have presented a troublesome problem in that section of Alaska; but, with the exception of a relatively few, most of the force were obtained in the locality. As a matter of fact but seven carpenters, two boilermakers, and a tunnel foreman had to be recruited from the States. Indirectly, this is a tribute to the handful of experienced men in charge of the work. Mr. Fred H. Tibbetts, civil engineer of San Francisco, was responsible for all designing; and he also had general supervision of the undertaking during construction.

Current at 33,000 volts is carried over a transmission line that traverses heavily timbered country for a distance of 27 miles. The right of way for this line, which links the powerhouse with Anchorage, has been sufficiently cleared to prevent damage and possible interruption to service by falling trees. There is every reason to believe that the availability of this energy will play a very important part in the industrial development of the district.

We wish to acknowledge our indebtedness to the *Anchorage Daily Times* for much of the information contained in this article.

Manner in which the N-75 drifters were mounted when driving the pressure tunnel.

DAMMING THE COLUMBIA FOR POWER

ROCK Island, on the Columbia River, is to be the site of a great hydro-electric plant to be built by the Puget Sound Power & Light Company. Work on this project is soon to be started, and will involve an expenditure estimated at $15,000,000. Three years will be required to construct the dam, which is to be about 60 feet high and 3,500 feet long and will back up the waters of the stream for a distance of twenty miles.

Initially, 80,000 hp. are to be developed, but this output is eventually to be increased to 200,000 hp. by the installation of additional turbines. With the exception of a small block of energy to be used near the source of supply, most of the current is to be transmitted over the Cascade Range to the cities of the Pacific Northwest.

The barrier thus to be placed in the Columbia, famous for its salmon, is to be provided with special fish ladders to enable the salmon to climb up and over the dam when making their annual journey from the sea to the quiet headwaters of the river for spawning. This part of the work is to be supervised by the United States Bureau of Fisheries.

Owing to the increasing use of the telephone in the conduct of business, the telephone companies of the United States have undertaken an enormous program of expansion during 1930. More than $100,000,000 is to be spent in amplifying long-distance facilities and telegraphic lines of communication between widely separated cities.

Colorado Association

A burro pack train, a seldom-seen sight in the West of today.

Yesterdays of the Gold Camps

Turning Back the Pages on Some Personalities, Incidents, and Events of the Boom Days

By C. H. VIVIAN

PEOPLE are always interested in anything that holds forth the promise of sudden wealth. Before the present industrial era got under way there was little opportunity to gain a fortune quickly except by digging it from the ground. These two apparently unrelated statements explain in large part the feverish excitement that attended the gold rushes of the West. An added factor was the spirit of adventure that is born in all of us. Every new camp was another frontier; the means for a brush with unknown things; a game that satisfied the human craving for something different, with gold and silver as the grand prize.

Most of those attracted by this magnet of chance tried their hand at mining. Along with them, though, went a vast army that was content to feed upon those who dug. In this floating horde were gamblers, saloon keepers, outlaws. There were few women, especially at the outset of a camp's life. Those who came later were mostly without caste. Every mushroom settlement was a heterogeneous mixture, a scrambled mass of good and bad, with the disciples of virtue frequently in the minority.

As a camp took form it gained some semblance of good behavior. It rid itself of the worst of the bad element and formulated a rough legal code that was enforced by extreme measures—even to the hangman's noose. Nevertheless, by choice of the majority, the typical camp was "wide open." Money was no good unless it could be spent, and it could be spent easier and quicker in riotous pastiming than in any other way. Even the best citizens condoned drinking and gambling as necessary evils of frontier life.

At times law and order were hard pressed to survive. When Leadville was at its height, it was dangerous to walk abroad on the streets at night. For protection, men carried pistols up their sleeves—walking with the muzzle resting in the palm of the hand so that their weapons could be put into instant action if required. When two friends chanced to meet, they extended hands and clanked their guns together in lieu of a handclasp.

Philip Johnston, Touring Topics

The Narrows in Surprise Canyon was the scene of many stage robberies when old Panamint was in her prime.

Everyone lived directly or indirectly from mining, and none was too exalted to swing a pick. Following his election as governor of Colorado in 1877, John L. Routt raised $10,000 among his associates in the statehouse at Denver and purchased the Morning Star Lode at Leadville. Forsaking his office, he donned overalls and boots to work underground. Now and then he journeyed to Denver to attend to some pressing affair of state, but most of his term was spent with a pick, shovel, or doublejack in his hands. His efforts were rewarded, for a strike of ore brought huge profits. He and his partners sold the Morning Star for $1,000,000. And, as far as the records show, he filled the office of governor to the entire satisfaction of his constituency.

Actual money was scarce in the camps, and gold dust or ore often served as a medium of exchange. There is a well-substantiated story of a saloon keeper who amassed a competence in high-grade ore without ever knowing the feel of a pick. His "emporium" was at Jamestown, Colo., where, incidentally, Douglas Fairbanks spent much of his boyhood. This saloon keeper accepted ore for drinks. It was his habit to heft each piece as it was passed over the bar and to appraise its value in terms of liquor. The pieces were thrown into a barrel. In a few months he had a number of barrels filled with choice ore and made a shipment to the smelter. After a few such shipments he retired.

During the early days of Cripple Creek, the local residents bought considerable stock in the Mary McKinney Mine at a few cents

a share. At first the mine showed no great promise as a producer, and the stockholders grew weary of waiting and tried to dispose of their holdings. To realize something on their shares, housewives began exchanging them with tradesmen for whatever they could get in groceries, meat, and other supplies. Later the Mary McKinney struck rich ore and yielded $10,000,000 in gold.

Where riches were won from the ground with such comparative ease, there was little sense of the value of money. Everyone spent freely when he had funds, and few stopped to consider that there would be bottoms to the mines. The camps were anxious to proclaim their wealth to the world, and nothing that they really wanted came too high. When Goldfield was seized with a whim for the famous Gans-Nelson prizefight, the $30,000 purse demanded was raised in half an hour of soliciting, with $20,000 added for good measure. The promoter of the match in San Francisco was skeptical when he got word, and boarded a train for the camp to investigate. To duly impress him, the citizens of Goldfield piled the cash in a bank window and led the matchmaker there from the railroad station to gaze upon it.

On another occasion, a committee of Goldfield citizens visited Carson City in an effort to persuade the state legislature to make their camp the county seat. As a gesture towards establishing their financial rating, they began to shower nickels to the newsboys and ended up by throwing $20 goldpieces about the streets. This display of wealth won them success in their mission, and they felt so elated that they invited the solons to visit their town and to look it over. They chartered a special train for the purpose, and entertained their guests lavishly upon their arrival in Goldfield. Washtubs were filled with champagne and everybody was given a ladle.

Since Wall Street is today synonymous in some minds with the quick and easy riches for which the boom camps once stood, it is interesting to note that mining contributed something to stock trading in its present form. On the Comstock Lode, the partners in a claim divided their holdings into feet in order that they might conveniently figure the share of profits to which each was entitled. This method proved cumbersome, and shares were substituted instead. This was the beginning of the modern stock company.

Many of our modern-day family fortunes took root in those western mining camps; and many men who later attained some measure of public prominence got their start on the business end of a "muck stick." Had it not been for the boom camps of Colorado, David H. Moffat would not have been able to project his railroad across the Continental Divide and to leave plans for the tunnel, bearing his name, that promises to exert a tremendous influence upon the economic development of the Rocky Mountain region.

As a young man, Moffat went from New York State to Colorado. He made money in mining and more money in banking, and became a leading figure in the railroad circles of the state. He was chairman of the board of directors of the Denver & Rio Grande Railroad when Creede was at the height of its boom that led Cy Warman to write, "It's day all day in the daytime, and there is no night in Creede." The people of Creede were clamoring for an extension of the railroad from Del Norte. The majority of the board showed reluctance, and wanted time to think the scheme over and to investigate. This irked Moffat, who was a partner of N. C. Creede in the Amethyst Mine, so he built the line out of his own pocket at a cost of several hundred thousand dollars.

Again, in later years, Moffat backed his faith with his dollars. Failing to interest New York capitalists in his plan to run a shorter road from Denver to Salt Lake City, he set out to construct it alone. He spent his entire personal fortune of $12,000,000 completing the road to its present terminus at Craig, Colo., and went to New York in a further effort to secure help. He died while on that mission. In recent years, citizens of Colorado bonded themselves for $18,000,000 to bore the tunnel that he had planned. When a 40-mile connecting link from its western portal to the Denver & Rio Grande Western's tracks is built under authority granted recently by the Interstate Commerce Commission, coast-to-coast trains will operate through the Moffat Tunnel.

Colorado Association

An early-day photograph of sluice miners at work.

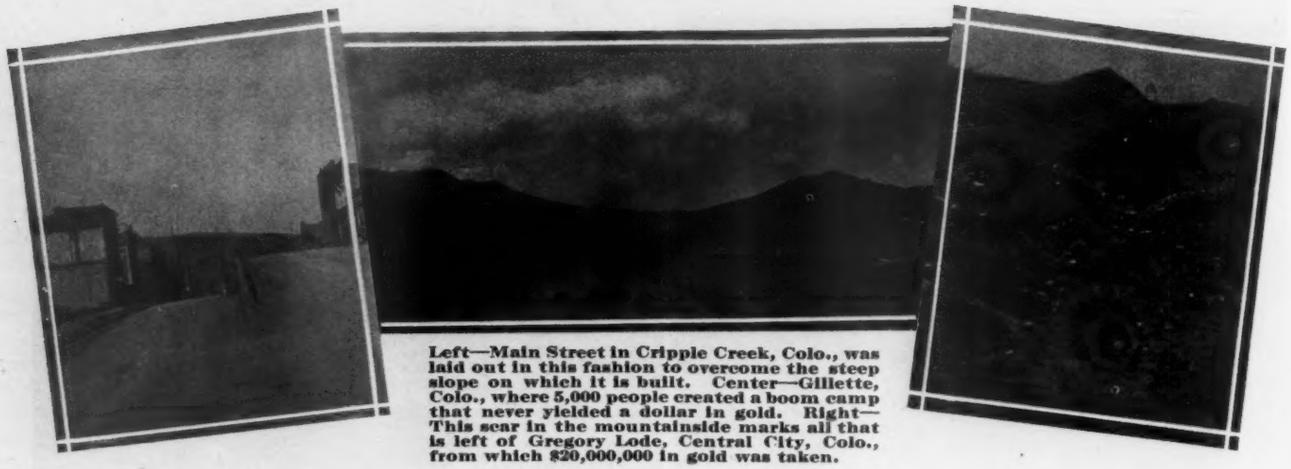
One of our greatest industrial corporations, the American Smelting & Refining Company, was born at Leadville. Meyer Guggenheim, a Philadelphia merchant, visited the camp in the early "eighties," when the lead-and-zinc-carbonate ores were coming from the ground in great quantities. He noticed the lack of adequate facilities for smelting the ores, and started a small plant for that purpose. Thus was laid the foundation for an industry that today reaches around the earth. Incidentally, the original Leadville plant grew to one employing 1,000 men. It is the only surviving smelter of the dozens that were built in Colorado.

In 1877 Levi Z. Leiter of Chicago purchased from A. B. Wood an interest in the Rock Mine, where silver was first discovered at Leadville. This marked the real beginning of the Leiter fortune of present times. The late D. W. Brunton of Denver, inventor of the Brunton pocket transit used by miners the world over, started his career in Leadville. In after years he became one of the most sought after mining engineers in the country and served as an expert witness in most of the encroachment cases that were fought in the courts of western mining states with millions of dollars at stake.

The most magical name connected with Leadville and one of the most magical of the entire West was that of Horace A. W. Tabor. Every mining venture he touched succeeded, and "Tabor luck" became a byword. For several years prior to 1877, Tabor kept a store at Oro City, in California Gulch, where

Colorado Association

1—Silverton, in the San Juan Mountains of Colorado, is still the center of considerable mining activity. 2—In its heyday, Black Hawk, Colo., was a symbol of great wealth and drew to it such distinguished visitors as President U. S. Grant, Horace Greeley, and others. 3—The Portland and, at left, Stratton's Independence—two of the extremely rich gold mines at Cripple Creek. 4—Ouray, Colo., has been called by many travelers the most picturesquely located town in the country. The Camp Bird and other large gold mines were situated near by. 5—Georgetown, Colo., was once a big producer of gold and silver.



Left—Main Street in Cripple Creek, Colo., was laid out in this fashion to overcome the steep slope on which it is built. Center—Gillette, Colo., where 5,000 people created a boom camp that never yielded a dollar in gold. Right—This scar in the mountainside marks all that is left of Gregory Lode, Central City, Colo., from which $20,000,000 in gold was taken.

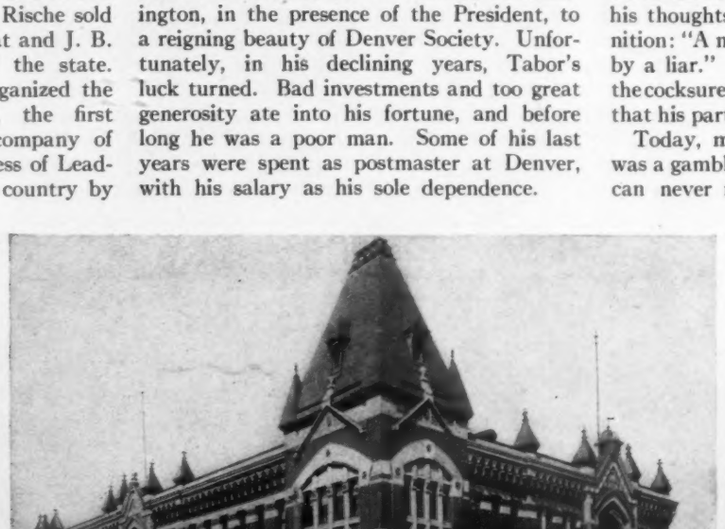
a sizable group sluiced the gold gravels. He saved $5,000. In April, 1878, two cobblers, August Rische and George T. Hook, asked Tabor for a grubstake and he gave it to them. They began to dig at the apex of Fryer Hill, which was then considered about the most unpromising spot in the area. In a few weeks their food was gone and they hadn't found a sign of ore. They returned to Tabor, reported on their operations and asked for more rations and tools. Again Tabor was generous.

In May, at a depth of 26 feet, Rische and Hook struck what developed into the Little Pittsburgh Mine, a property that amazed the financial centers of the nation by its richness. Almost from the start it yielded profits of $8,000 a week on a few tons of ore. Within a few months, Hook and Rische sold their holdings to David H. Moffat and J. B. Chaffee, afterwards governor of the state. Tabor and his new associates organized the Little Pittsburgh Consolidated, the first highly capitalized gold-mining company of the country. The fabulous richness of Leadville was known throughout the country by that time, and Wall Street capitalists bought $5,000,000 in stock. Dividends of $100,000 a month were paid for several years, but ceased abruptly when the end of the high-grade ore was reached. Tabor's luck was with him, however, and he sold out to his associates for $1,000,000 just before the rich ores were exhausted.

He invested some of his profits in Denver bank stock, but put most of them back into various Leadville mines. Most of these became good producers, and the country marveled at the ease with which Tabor amassed millions. One of his partners in some of the Leadville ventures was Marshall Field; so the famous old camp once more contributed to the upbuilding of a notable American family fortune.

Tabor left his mark on Colorado in the form of banks, industries, railroads, and philanthropies. His one venture in mining without associates was the purchase of the Matchless Mine for $117,000. He told friends he wanted something all his own. The Matchless yielded him profits of $2,000 a day for several years. With a portion of the money he built the Tabor Grand Theater at Denver, a playhouse without an equal in the country at the time. He opened it in a blaze of glory and splendor with the best talent the world afforded. A few years ago the Tabor passed into the hands of the motion-picture people. Remodeled, it still graces the business section of Denver.

Colorado elected Tabor to the United States Senate; and he was married at Washington, in the presence of the President, to a reigning beauty of Denver Society. Unfortunately, in his declining years, Tabor's luck turned. Bad investments and too great generosity ate into his fortune, and before long he was a poor man. Some of his last years were spent as postmaster at Denver, with his salary as his sole dependence.



Colorado Association

The Tabor Grand Opera House, at Denver, as it appeared in the days of bicycles and horse-drawn vehicles. It was built by Horace A. W. Tabor with some of the wealth that came from the Matchless Mine at Leadville.

Upon his death, he left his widow little except the Matchless Mine, then worked out, mortgaged, and idle. Mrs. Tabor dreamed of a new fortune from the famous old property, and sought to work it. It failed to pay, but she clung to the idea tenaciously; and during recent years lived in a shack on the premises and directed the operations. On four occasions "Tabor luck" enabled her to redeem it after it had been put up at the sheriff's sale. In April of this year, however, she lost the long fight, and the mine passed from her hands when she failed to meet a $16,000 mortgage.

Thus the old camps witnessed much of the bright side of life and probably an equal amount of the dark side. Mark Twain spent a lot of time in the West of those days and put his thoughts on mining into the classic definition: "A mine is a hole in the ground owned by a liar." He gained that impression from the cocksureness of everbody who owned a claim that his particular holdings would prove rich.

Today, mining is a business: yesterday it was a gamble. The glamor of the old camps can never return. The prospector and his burro train have passed from the scene. The dance hall, the claim-jumper, the high-grader, the long lines of ore wagons exist only in the movies. The grass grows untrampled in the streets of many one-time populous communities; and the whistles no longer blow to call the night shift into the bowels of the earth and the day shift up into fresh air and the din of revelry. Houses, deserted for years, are tumbling into ruins. Dotting the surrounding hillsides, rusting stacks that will never again belch smoke stand stark against the sky. The second-hand man has stripped away most of the costly machinery; and the ore dumps that were worth shipping have been sent through mills and smelters to leach from them their last bit of pay dirt.

Most of the old camps of the West are rich today in only one thing—memories.

Portable Compressors Facilitate Work of Concreting a 22-Mile Embankment

Applying concrete to the surface of the canal embankment by means of compressed air.

AN example of the efficient utilization of running water to serve the needs of mankind is found in the Colfax district of California, where the runoff from one watershed is used six times—five times for the generation of power and once for irrigating farmlands. The power development is under the direction of the Pacific Gas & Electric Corporation, one of the foremost public utilities on the Pacific Coast.

At the upper end of the system the Bowman Dam, located high up in the Sierra mountains, impounds the headwaters of the Bear River. This dam is under the control of the Nevada Irrigation District. From the dam site, the water flows to Spalding, where it passes first through Plant No. 3 and, later, through Plant No. 2. It then goes through the Drum Power House and into the Bear River. A little farther down, the stream is diverted through the Halsey Power House and, finally, through the Wise Power House. At still lower levels the water is distributed to numerous farms, where it is used for irrigating purposes.

To convey the water at the upper levels, a system of canals, 22 miles long, was constructed. This work consisted mainly of enlarging existing smaller canals that dated back to the gold-rush days. The canal system traces its course along the sides of mountains; and in order to reduce the loss of water through seepage and to strengthen the outer embankment, the latter was faced on the inside with concrete. This material was placed pneumatically, and the general manner in which the work was done is shown in the accompanying illustrations. Reinforcing wire was placed in position, and the concrete shot through it and built up upon it by directing an air spray at right angles to the surface.

Standard equipment was used throughout. This included a hopper for mixing the sand and the cement, of a flexible hose for delivering the mixture to the point of use by means of compressed air, and of a suitable arrangement for the introduction of the required amount of water just before the discharge of the material from the nozzle in the operator's hands.

Three concreting outfits were on the job—the air for each being furnished by an Ingersoll-Rand portable compressor. The facility with which these machines can be moved over the ground contributed much to the speed with which the work was performed. A total of approximately 12,000 cubic yards of concrete was placed in this manner; and it was thus possible to concrete with each outfit as much as 300 lineal feet of canal embankment a day or an aggregate of 900 feet daily.

One of the three concreting outfits that were used on the job.

What is said to be the world's largest known deposit of beryl crystals has been uncovered in the Bumpus feldspar quarry at Albany, Me. The biggest of the 25 crystals, having an aggregate weight of 200 tons, is said to tip the scales at 18 tons. Far heavier individual crystals of this kind have been found in the past, but this is the first time that so many have been discovered in one bed. Geologists who have examined the Albany crystals say that they are of excellent quality and should be preserved.

Ewing Galloway, New York

Steamers of the kind Mark Twain knew well still ply our Western rivers.

Charting South American Skies

By CAMERON ROGERS

SINCE Francisco Pizarro, the conqueror, first scuffled the sand of Tumbez Beach, his first foothold in South America, no other conquest of that great continent has achieved such significance as this latest of all conquests, that of its skies.

Today, from Cristobal, in the Canal Zone, down the endlessly changing Pacific Coast to Magallanes, near the Horn, over the Andes to Argentina and Uruguay, Paraguay, Brazil, and the Guianas, in the uplands of Peru and Bolivia and the interior of Colombia, air liners—not merely individual planes exploring uncharted skies—shuttle back and forth upon their lawful occasions.

All this activity, this air enterprise, is with one exception hardly two years old, and some of it not yet one. Two years ago there was but one established air line in South America—that of the Sociedad Colombo Alemana de Transportes Aeros, better and more readily known as "Scadta", operating only in Colombia. This line was inaugurated in 1919 and, today, covers more than 2,720 miles of airways.

In this year of Grace, besides Scadta, there are in South America the Compania Lloyd Aero Boliviano, in Bolivia, with a total mileage of 2,198; the Peruvian Navy Air Service between the coast and the interior of Peru, with a mileage of 1,100; the Chilean Army Mail Service between Arica and Magallanes, Chile, 2,000-odd miles in extent; the Compagnie Generale Aeropostale, between Santiago, Buenos Aires, and Rio de Janeiro; the Condor Syndicate covering a mileage of 1,011 between Rio, Rio Grande do Sul, and Puerto Alegre; the Faucett Aviation Company with 1,200 miles of airways between Chiclayo and Arequipa, Peru; the New York, Rio and Buenos Aires Line, operating between Santiago, Buenos Aires, and Rio de Janeiro; and, finally, what is said to be the longest continuous air-mail line in the world, that of the Pan American-Grace Airways Incorporated, which, in conjunction with the Pan American Airways, carries mail under contract with the United States Government from Montevideo, Uruguay, to the United States, via Chile, Peru, Colombia, Ecuador, and the Canal in just eleven days. It is upon this last air line that we will concentrate, since it is the longest to carry foreign mail under a United States Government contract and is the most internationally inclusive of them all.

Pan American-Grace Airways Incorporated is known in South America as the "Panagra" line, and as such we will refer to it. It is almost the youngest of those in operation, not a year old, and yet in nine months its planes have extended their schedules from Peru south to Chile, from Chile over the vast wall of the great Cordilleras into Argentina, and from Buenos Aires east across the Rio de la Plata to Montevideo.

Its genesis, originally west-coastal, expanded what had been the scope of the Peruvian Airways Corporation, a concern operating in the fall of 1928 between Talara and Lima, Peru, and later between Guayaquil, Ecuador, and Mollendo, Peru. Incorporated in the early months of 1929, the Panagra system was designed greatly to extend this route, to cover the entire coast, and, eventually, to span "the hill", as the pilots optimistically term the colossal spine of the Andes.

Having secured the Government mail contracts, the company's planes hit the sky in May of last year to inaugurate the first inter-American air-mail route. On the maiden trip between the United States and Peru three machines were used, a Sikorsky, from Miami to Cristobal, a Loening from Cristobal to Talara, and a Fairchild from Talara to Lima and on south to Mollendo, the first terminus of the route. Pitcairn Airways flew the mail between New York and Miami, Pan American Airways between Miami and Cristobal, and Pan American-Grace Airways between the Canal Zone and Mollendo.

Close-up of an Ecuadorian volcano as seen from the vantage point of a speeding Panagra liner.

But Mollendo did not long remain the southern terminus. On July 1, Second Assistant Postmaster General W. Irving Glover announced that mail service over the route—F. A. M. Route No. 9—was to be extended to Santiago, Chile, on July 16. And

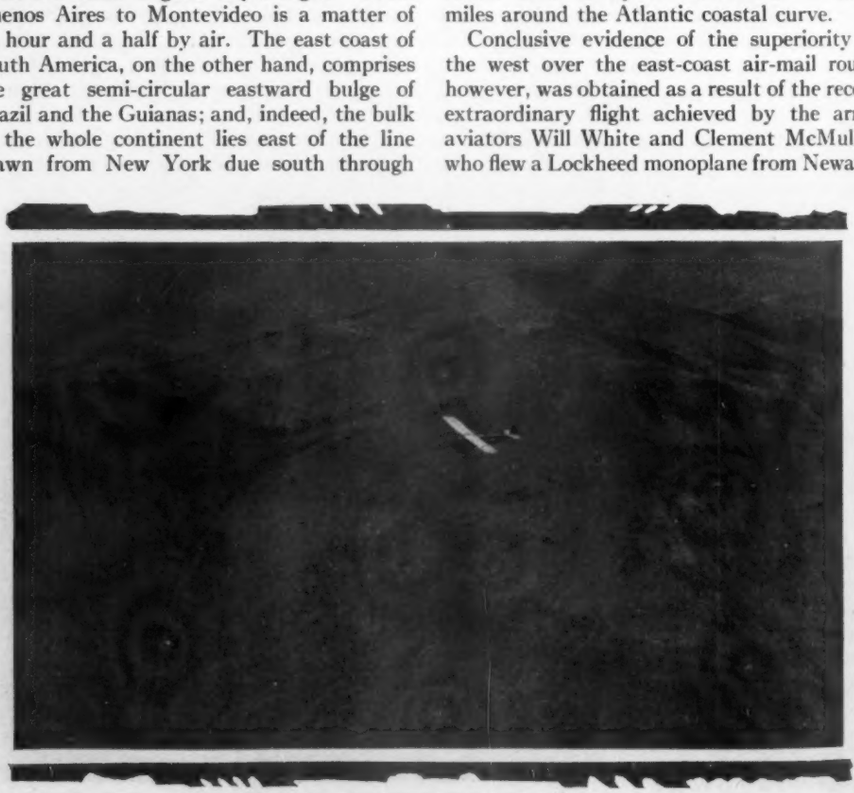
Las Palmas, Lima's airport, with part of the Panagra fleet on the ground.

on October 10 yet another official dictum lifted the long line over the Andes and across the *pampas* to Buenos Aires. And so it went. Six weeks later a further extension fixed the southern terminus of the Panagra system in Montevideo. Flying equipment during this time had been coördinated, amplified, and improved. Tri-motored Fords now carry passengers between Talara, Peru, and Arica, Chile, and the smaller Fairchilds render auxiliary service twice weekly from Lima north and south along the coast on the schedule of the Peruvian Airways Corporation, now a division of the Panagra.

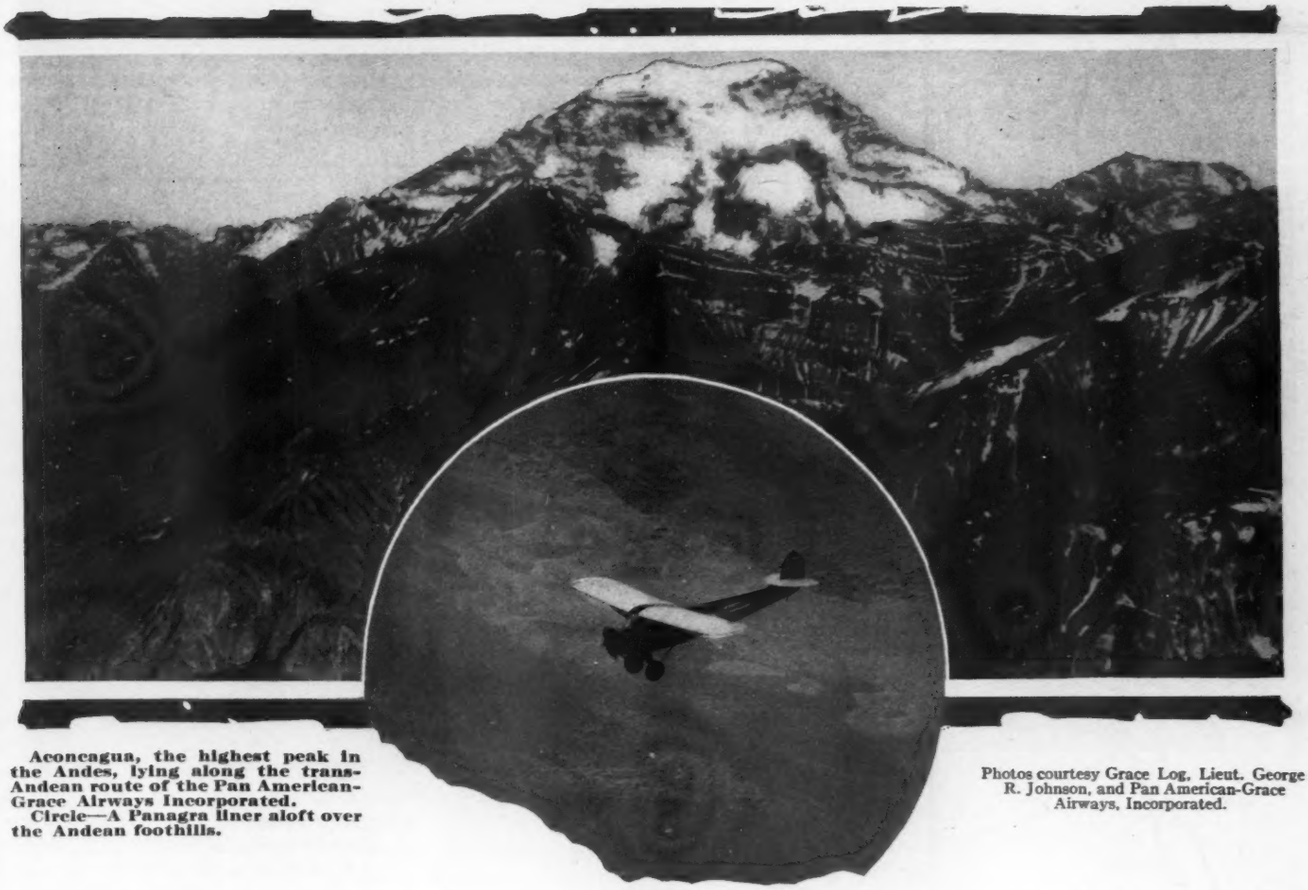
The mail to and from the United States and Ecuador, Colombia, Peru, Chile, Argentina, and Uruguay moves on a weekly schedule of eleven days between Uruguay and New York City; ten between Santiago, Chile, and New York; seven between Lima, Peru, and New York; six between Guayaquil, Ecuador, and New York; and five days between Buenaventura, Colombia, and New York. There are other points in all of these republics where the mail planes stop, but such, roughly, are the time intervals between these six nations and the northern terminus.

As has been said, the foregoing is today a weekly service, but not long ago the United States Post Office Department indicated its intention of increasing it to twice weekly. Since this announcement was made, individuals of inquiring minds have asked themselves and others the question why mail from Argentina and Uruguay should fare to the United States via the west and not the east coast? This is easily explained. Lay a ruler along an imaginary line running north and south from New York through South America, and you will see that Santiago is very nearly on that line with Buenos Aires to the eastward less than a good day's flight. From Buenos Aires to Montevideo is a matter of an hour and a half by air. The east coast of South America, on the other hand, comprises the great semi-circular eastward bulge of Brazil and the Guianas; and, indeed, the bulk of the whole continent lies east of the line drawn from New York due south through South America. The fact that the continent narrows sharply at Buenos Aires makes it eminently practical, therefore, to make the hop west to the Pacific and then almost due north rather than to fly the thousands of extra miles around the Atlantic coastal curve.

Conclusive evidence of the superiority of the west over the east-coast air-mail route, however, was obtained as a result of the recent extraordinary flight achieved by the army aviators Will White and Clement McMullen who flew a Lockheed monoplane from Newark,



A Panagra liner high above the Andean foothills.



Aconcagua, the highest peak in the Andes, lying along the trans-Andean route of the Pan American-Grace Airways Incorporated.
Circle—A Panagra liner aloft over the Andean foothills.

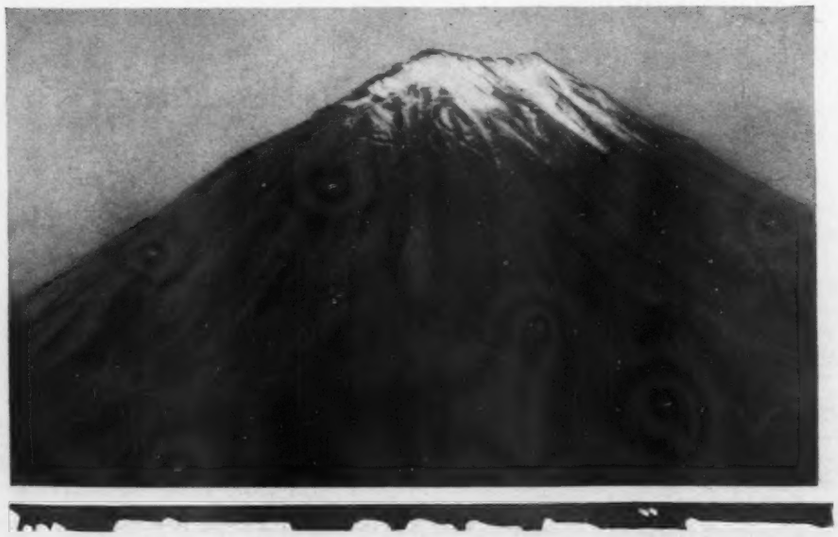
Photos courtesy Grace Log, Lieut. George R. Johnson, and Pan American-Grace Airways, Incorporated.

N. J., to Buenos Aires, Argentina, via the west coast, in five days and five hours elapsed time and in but little more than 52 hours of actual flying time. This record is suggestive of what the Panagra air-mail service may hope to accomplish.

Such are the facts regarding the operations in South America of the longest air-mail route in the world to perform under contract with the Government of the United States. But what are the conditions under which the air liners, the passenger and mail planes, themselves, do their work? Are Peruvian skies like our skies, changeable—now blue, now gray, now high ceilinged, now low? Or are they always blue, always clear, swept by a fine clean wind, never too strong, and free of fog? What of Chilean skies, and those of the great Argentina *pampas* and, above all, the skies shouldered by the bullying gale-swept peaks of the Andes?

Well, according to the pilots, South American skies are much like those which look down on the world in other latitudes and climes. There is fog on the west coast, but it is friendly and easily enough avoided. There are high winds hooting around the towering cornices of Aconcagua, the highest peak of the Andes which the Panagra's trans-Andean planes must pass; but the liners—flying, as the saying goes, high, wide, and handsome—make little enough of it. Of course, there are the minor, multiple mishaps on the ground, which characterize the daily routine of every great transportation line of any sort. But, on the whole, the west-coast, trans-Andean, and trans-Rio La Plata run proceeds as smoothly as silk. Between Santiago and Buenos Aires it is like no other air line now in operation. One might safely call it the highest and the lowest in the world, since between Santiago's airport and Mendoza, in the eastern spurs of the Cordilleras, the big planes travel over the Andean wall at 18,000, 19,000, and sometimes 20,000 feet. And then, between Mendoza and the Moron field at Buenos Aires, the pilots might fly no higher than 50 feet across a checkered *pampa* floor flatter than a man's hand from mountain scarp to sea. Indeed, were the fences of the great *estancias* removed, a plane might be taxied for 500 miles as easily and smoothly as though it moved upon asphalt.

In Panagra planes and as an observer, the writer flew over northern Peru where the strange, wind-dimpled dunes lift like the smooth backs of porpoises out of the low, drifting mist that sometimes swirls between the Pacific breakers and the hills, over the guano-capped bird rocks where thousands of sea fowl congregate, breed, and vociferate,



Illiniza, 17,500 feet high, close to the air route in Ecuador.

Map of the route covered by the planes of the Pan American-Grace Airways Incorporated.

over the great Bolivian *altiplano* or plateau, 14,000 feet above sea level, and between the volcanoes of Sajama and Payachata. But none of his experiences then could compare with his sensations when, quite candidly emotional, he passed by air from Santiago to Buenos Aires. He had been promised by the pilot, a redhead now famous at all the landing fields between Santiago and Montevideo, that he would see wonders. A tip-tilted lake, a waterfall flowing upwards, and pink ducks were among them. And though the first of these miracles was a glacier, the second an optical illusion caused by gales which fling upward the spray of the fall, and the third proved to be flamingoes in the shallow topaz *pampa* lakes, the writer marveled at them all.

But enough of subjective experience. Anyone bound for an air vacation can now travel from the United States by Pan American and Pan American-Grace airways, and by Chilean National, New York Rio and Buenos Aires, and Condor air lines across spaces Pizarro never dreamt of and which would have caused Balboa—forgive us, Keats—to have shed his silence swiftly on his peak in Darien. And, remember, all this is the work of scarce two years, some of it the achievement of not yet one.

Who called South America the land of tomorrow? Who spoke of Pan-American tropical and sub-tropical regions as the ultimate hide-out of the hopeless mañana fiend? Dispel such rumors. South American republics, their skies charted and familiar, are today not only abreast of the times but, in some cases, a couple of jumps ahead.

PNEUMATIC CONVEYOR FOR HANDLING BULK LIME

LIME, due to certain inherent properties and to the fact that it must be protected from the weather, requires more care in handling than other kindred bulk materials, such as sand, etc. This, at least, is the experience of the National Brick Corporation, of Long Island City, N. Y., which, after studying the subject from all angles, has installed a pneumatic-conveyor system at its plant for the unloading of lime, which is delivered there aboard floats of four cars each.

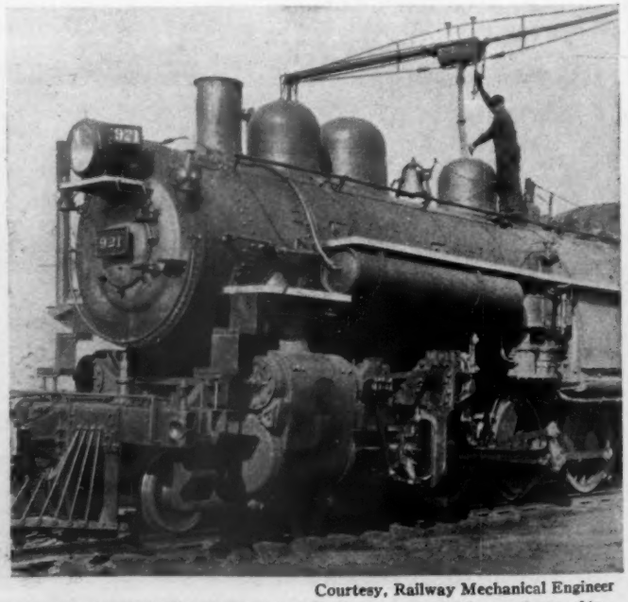
By means of this system the material is carried by suction from the cars to a combined receiving hopper and bag filter that is located about 10 feet above the bins supplying the hydrator room, which is 30 feet up from the dock level and 70 feet back from the bulkhead line. The bottom of the receiving hopper is hermetically sealed; and it is equipped with a 4-compartment discharge lock that is revolved by a 2-hp. motor so as to assure a continuous flow of the lime into the bins beneath. The function of the filter is to collect all the fine particles of lime that might otherwise be wasted—the contents of the bags being automatically shaken out at short, regular intervals by the use of a vibrator actuated by compressed air at about 45 pounds pressure.

The operation of the system, according to H. J. Levine of the National Brick Corporation, is extremely simple. One man pulls the flexible hose into the car which is to be unloaded and plunges the nozzle deep into the lime. The motors driving the vacuum pump and revolving the discharge lock are started simultaneously. When the lime reaches the receiving hopper, with its comparatively large cross section, the velocity of the material is suddenly diminished, and it drops thence through the lock into the bins beneath. The contained air, after being relieved of every trace of lime, is exhausted into the atmosphere by way of an 8-inch pipe line connecting with the top of the receiving hopper. This withdrawal is effected by a vacuum pump driven by a 50-hp. motor. The conveyor has a maximum capacity of about 10 tons of lime per hour.

AIR-AND-GRAVITY FEED SYSTEM FOR SANDING LOCOMOTIVES

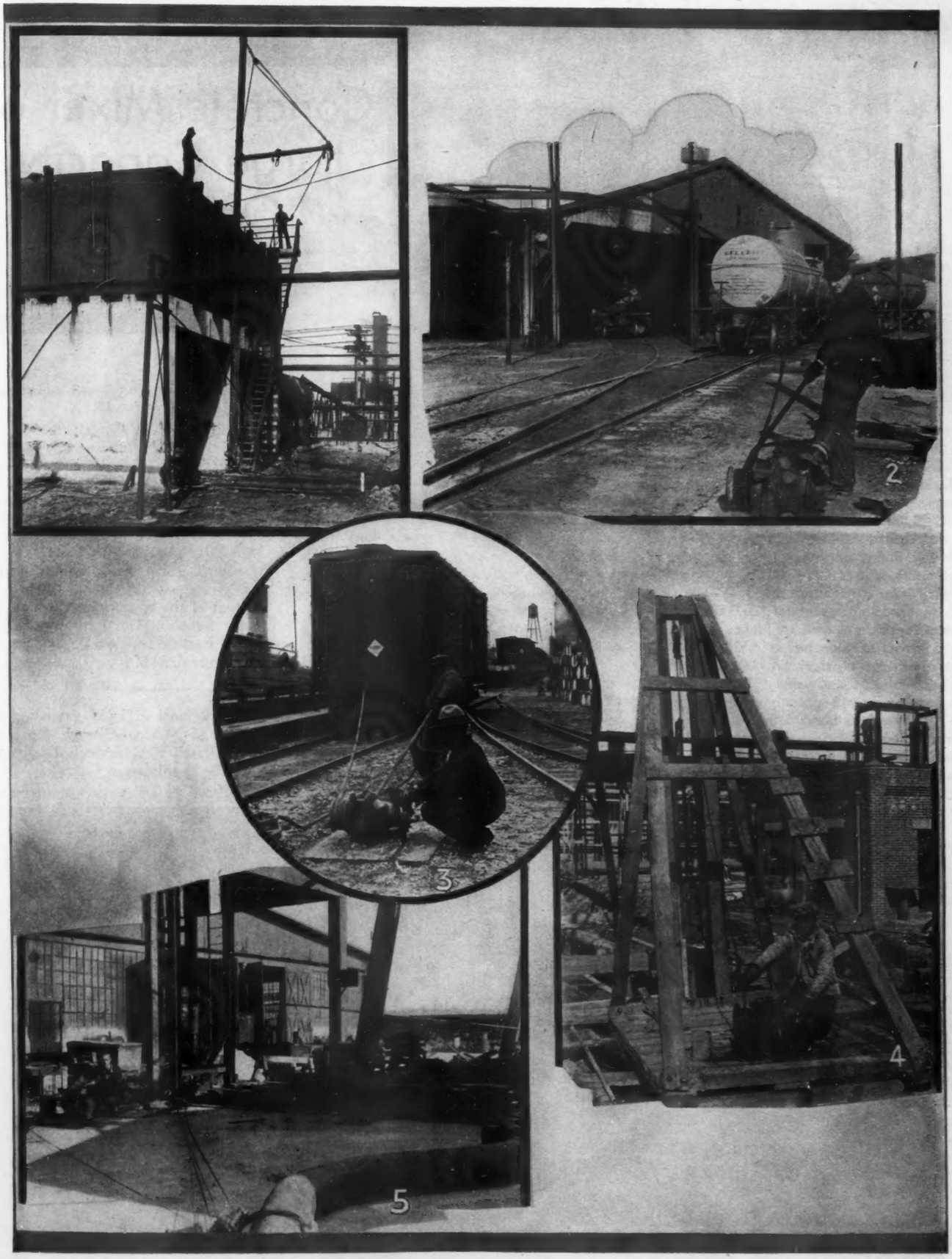
FILLING the sand domes of locomotives at the Wilkes-Barre, Pa., terminal of the Delaware & Hudson has been greatly simplified since that road has put in service there a pneumatic-and-gravity feed system of simple design. The apparatus consists of a 2-inch pipe line that leads from the main source of supply in the sand house to a small cylindrical reservoir that is suspended midway between the tracks near by. To this point, that is, the reservoir, the sand is delivered by compressed air—the material falling thence by gravity into the dome of the engine that has been run beneath it.

The control mechanism or valves of the feed system are at the overhead reservoir, an arrangement that has made it possible to dispense with the services of the man otherwise necessary in the sand house. This is not the only advantage the apparatus has to offer: it assures a more uniform flow than the method previously in use at that terminal. This is obtained by means of a series of baffle plates against which the sand strikes on reaching the reservoir and before falling into the locomotive dome. The impelling air is exhausted through two ports in the top of the reservoir. These ports are screened to prevent the sand from blowing out and over the engine. The nozzle through which the sand is finally discharged is equipped with two Barco joints—that is, it is flexible so as to permit the taking on of sand within a distance of 5 feet on either side of the reservoir.

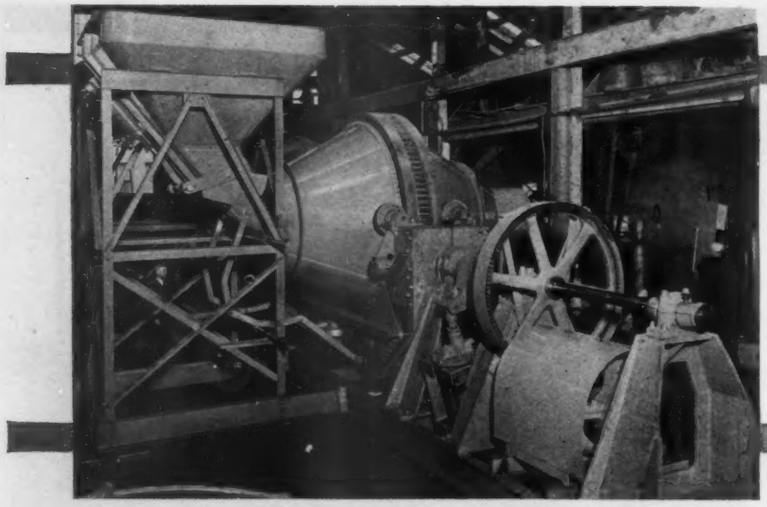


Courtesy, Railway Mechanical Engineer

An engine taking on sand with the pneumatic-and-gravity feeder installed at the terminal of the Delaware & Hudson at Wilkes-Barre, Pa. Only one man is required to operate the system.



Some of the many uses to which the adaptable air-driven "Utility" hoist can be put. 1—Raising condensing-coil piping from the ground to the box in an oil refinery. 2—Shifting and spotting tank cars in the yard and the sheds of a repair shop. 3—Moving freight cars at a dock. 4—Operating a hammer for driving sheet piling. 5—Helping in the bendling of 16-inch pipe.



Concrete Mixer of Large Capacity Operated Pneumatically

Close-up of one of the concrete mixers in loading position. On the left underside of the hopper is the air-operated piston that opens and closes the hopper gate, and just this side of the frame supporting the mixer can be seen the pneumatic ram that tilts the drum.

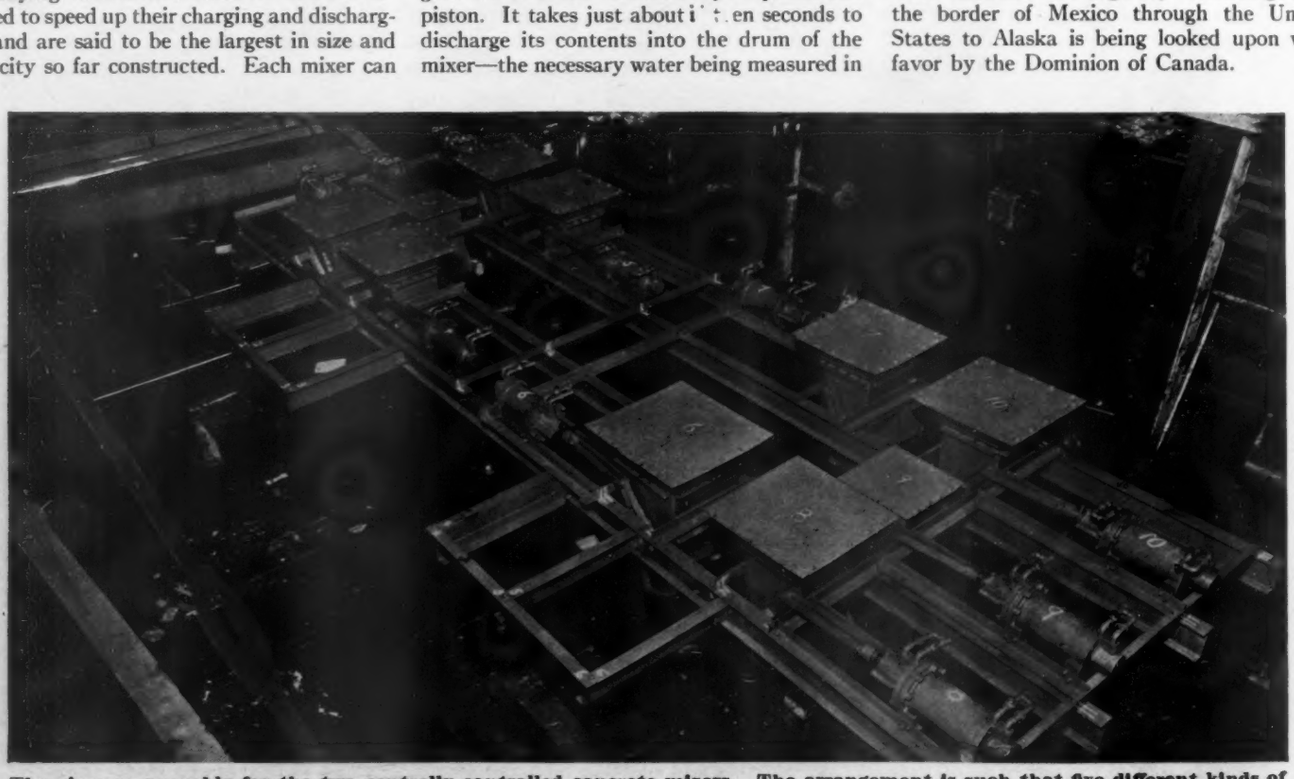
IT IS expected that the world's record for placing concrete will be made by the General Construction Company in building the Owyhee Dam, 21 miles southwest of Nyssa, Ore., for the United States Reclamation Service. This arch-and-gravity-type dam will have a maximum height of 405 feet and, when completed, will create the principal storage reservoir for the irrigation of 120,000 acres in eastern Oregon and western Idaho.

The project calls for the use of 520,425 cubic yards of concrete of which 490,000 cubic yards will be required for the dam. This concrete is to be mixed in two specially made machines embodying various new features that are designed to speed up their charging and discharging and are said to be the largest in size and capacity so far constructed. Each mixer can handle a batch of 4 cubic yards every three minutes, giving it a capacity of 80 cubic yards an hour or a total of 1,280 cubic yards each 16-hour working day. But one man is needed to operate the machines with their respective hoppers, and this he does from a central control station overhead.

The cement reaches each hopper by way of a spiral conveyor, and the different aggregates are fed to it through openings that are controlled by a series of air-operated rams—the proper proportion in each case being assured by an arrangement of scales. The hopper has a 34-inch outlet and a quick-opening gate that is also actuated by a pneumatic piston. It takes just about i t.en seconds to discharge its contents into the drum of the mixer—the necessary water being measured in piston-displacement tanks and added to the batch during that interval.

When in use, the drum is revolved continually by an electric motor, and the mixing begins the instant it is loaded. As soon as the batch is ready, as indicated by a special timing apparatus, the operator tilts the drum a matter of 65 degrees by another pneumatic ram. This is accomplished in five seconds, and in ten seconds more the mixer is emptied. Because of the sharp angle at which the drum is set for dumping, the discharge of the last 25 per cent of the batch is not slowed up as is usually the case. The drum is returned to its normal loading position by the last mentioned pneumatic ram.

An international highway extending from the border of Mexico through the United States to Alaska is being looked upon with favor by the Dominion of Canada.



The air-ram assembly for the two centrally controlled concrete mixers. The arrangement is such that five different kinds of aggregate can be fed into the hopper of each mixer, the respective gates being opened and closed by as many air-operated pistons.

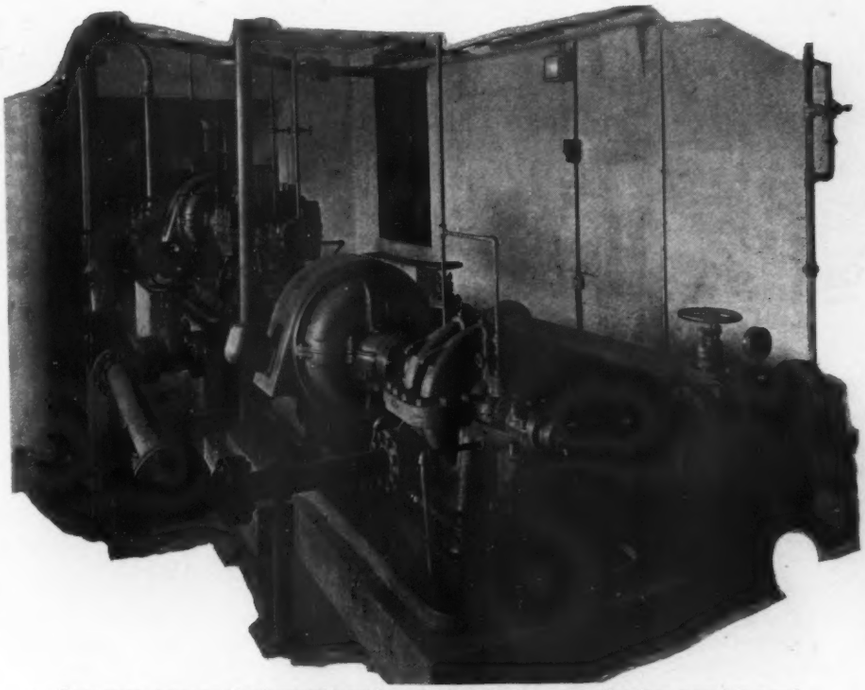
Old Miner Shows Foundry Way to Cut Costs

Proves that High-Pressure Streams Can Wash Out Sand Cores with Astonishing Rapidity and Save Much Time and Money

By A. S. TAYLOR

ACCURACY, economy, and dependability are terms that are synonymous the world over for the performance of the machine tools built by The Bullard Company.

Scores of plants in numerous places are equipped with Bullard equipment of various sizes and for a diversity of purposes; and wherever these machine tools are found in service they represent the cumulative and ripe experience of fully half a hundred years. They are the outcome of inventive cunning, engineering skill, and New England conservatism. The latter contribution might seem offhand to be a drag on the exercise of the other factors, but in this instance such is not the case.



Cameron pumps that supply water at high pressure to the two nozzles used in cleaning cores from castings. The near pump is a 2-stage unit while the one beyond is a 4-stage unit. Together they discharge 450 gallons of water per minute at a pressure of 425 pounds.

Conservatism as exemplified in Bullard products has never been a brake on progress: it has been exercised only as a protection for the customer in order that nothing should be offered him until thoroughly proven worth while. This concern is ever on the alert for any method or means that will enable it to turn out its products successfully and economically. This policy is the reason for the present article. It has to do with the foundry department of that company's up-to-date Bridgeport plant and with the facilities now employed there in breaking out the cores of sizable castings.

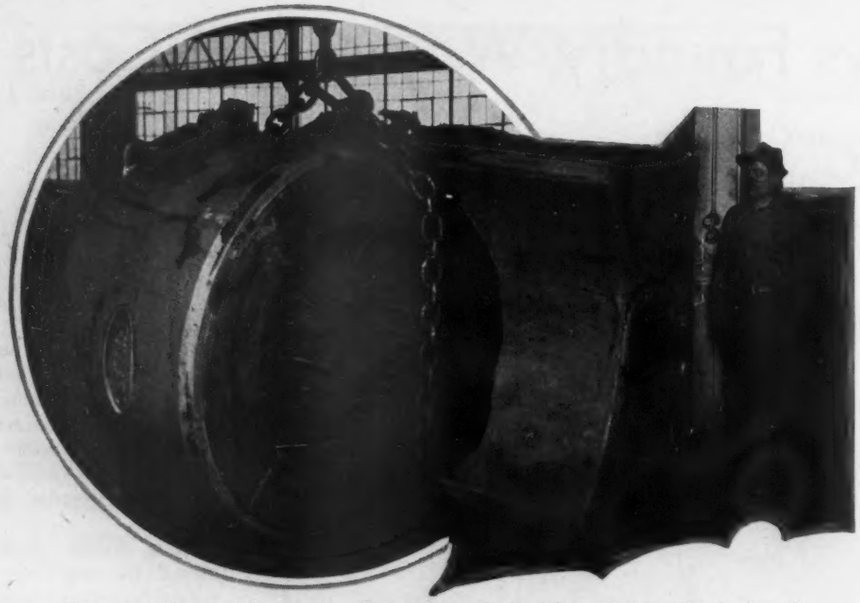
Most of us live so close to our jobs that we become static and lacking in originality. Not infrequently an outsider, unfamiliar with our routine problems, can point the way to betterment—showing how a fresh mind, with a new perspective, can see what we cannot see. Core-breaking is ordinarily a tedious and a more or less expensive operation, and quite commonly performed with picks and bars. It is dirty work and hard work, at best. It is generally accepted as incident to the business—an unavoidable evil, if you will. Such being the case, who would expect a miner to suggest a practicable method of dealing with the problem: an utterly revolutionary means that would effectually and quickly dispose of the cores in large and complex castings? Just the same, that was what an old "washman", a grizzled ex-hydraulic miner from the West did for The Bullard Company. Instead of using a high-pressure nozzle with an ample volume of water to wash down hillsides in quest of precious metals, he showed the doubters what similar equipment could do in the company's yard—all by way of demonstrating that he was right.

Let us quote in part from the *Connecticut Industry*, wherein is told how The Bullard Company was induced to radically change its way of breaking out sand cores. Certain members of the organization had treated the old fellow's pet idea with the characteristic skepticism of supposedly superior knowledge; but, being friendly disposed, they finally decided to give the retired miner a chance for a show-down. He was permitted to rig up a small monitor nozzle on a high-pressure line, and a casting was laid out in the yard where he could do what he could in washing out the sand core.

With everything ready, "A valve was swung wide open and a hissing stream, with a pressure of 200 pounds behind it, shot through the nozzle. He directed the stream at a secondary case casting lying on the ground about 12 feet in front of him. The observers, at a safe distance, saw the stream hit the black hard-baked core inside the case and a sheet of black sand and water fanned out into the air. In ten minutes, the inside of the case was clean as a whistle—a job that had ordinarily taken 40 minutes by hand pick.

Thus Frank Smith blazed the way for a radical departure in core-breaking at the plant of The Bullard Company; but the old fellow died before his scheme could be developed for regular service. He had shown, however, that the method was feasible, although there were engineering problems that would have to be solved before suitable equipment could be provided that would make commercial application worth while. It took months before success was won and facilities were installed that would permit the cleaning of a 4-ton casting, containing 34 cubic feet of internal cored space, in the course of two hours. That casting had only two or three sizable openings through which the core could be reached; and ordinarily it would have required from 35 to 40 hours of labor with hand tools to remove the hard-baked sand! Now that core-cleaning plant is working day in and day out and saving The Bullard Company a deal of time and money.

Instead of the pump used experimentally, which was pretty nearly wrecked in developing the pressure asked for by Frank Smith, the installation now consists of two powerful centrifugal pumps that, when working in series, are capable of building up a pressure of 425 pounds and of discharging from either of two 7/8-inch nozzles a volume of 450 gallons of water a minute. These figures, in themselves, fail to convey to the average mind any accurate conception of the disintegrating force exerted by those streams; but a glimpse into the commodious steel-clad chamber when but one of the nozzles is in action is spectacularly revealing. The attacking water simply blasts the baked cores, scatters the sand hither and thither, and strips the supporting metal gaggers and arbors until they are as bare as bones denuded of every particle of flesh. The water does its work



Large casting, with core in place, about to be lowered into the hydraulic core-cleaning room.

with thoroughness and with an uncanny relentlessness—searching out every corner and pocket in disposing of the hard-baked sand. Perhaps a somewhat detailed description of this core-cleaning plant will make for a more comprehensive grasp of what it represents in the way of a departure in foundry practice.

First we have a rectangular reinforced-concrete chamber 20 feet wide, 20 feet long, and 13 feet high, and with a hatchway in the ceiling covered by a sliding top mounted on wheels and traveling on rails. When this cover is shoved aside, castings can be lowered by a crane from the foundry floor or raised in the same way from the cleaning chamber which is in the basement of the building. In the center of the hydraulic cleaning compartment there is an electrically controlled turntable, made of cast steel 3 inches thick. The top of the turntable alone weighs 3½ tons. The table is overlaid with 3-inch timber upon which is placed a shield of ½-inch boiler plate. The object of all this sturdiness is to provide a defense against the intensely erosive action of the high-pressure streams and the core sand scattered by them. Similarly, the wall directly opposite the nozzles is sheathed by plating.

The turntable, which was designed by The Bullard Company and which is actuated by a 7½-hp. motor, is controlled by push buttons placed within easy reach of the operator when he is working at either of the two nozzles. The table may be made to revolve steadily by the pushing of a black button, and will continue to turn until a nearby red button is pressed. Continuous movement is termed "On run". An "On jog" button enables the operator to give the turntable short movements of any desired arc—the table traveling only so long as his finger is on the button. In this way the man at the nozzle can alter the position of the casting at will so as to expose it for the most effective action of the attacking stream.

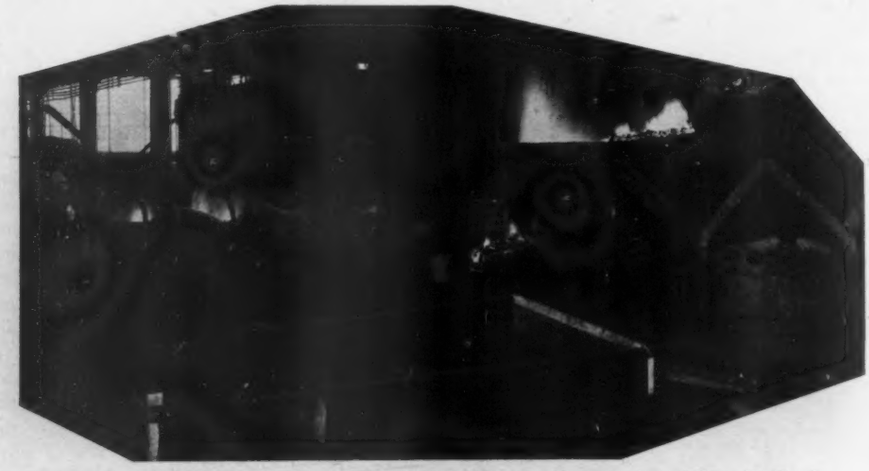
The nozzles—one high and one low—are mounted outside of the cleaning chamber and behind a heavy reinforced-concrete wall; and each nozzle projects inward through a rectangular port that is sealed with a heavy and baggy rubberized fabric that encircles the nozzle back of the outlet in a way to permit freedom in directing the stream. The "guns" are what are known as Morse swivel-type nozzles; and each surmounts a Jenkins high-pressure gate valve. Above each nozzle is a 2-paned observation window glazed with heavy plate glass and protected on the chamber side by a stout 1-inch mesh screen. This is a necessary precaution, because the streams of water scatter pieces of the core reinforcing rods with the velocity of flying projectiles. According to the size of the casting to be cleaned and the positions of the openings that expose the cores, the operator uses either the high or the low nozzle—shifting from one to the other as occasion requires.

In order that the work may be suitably illumined through the clouds of hurtling spray and sand, the cleaning compartment is lighted by four 1,000-watt Davis projector flood lights, manufactured by the Crouse-Hinds Company. There are two of these flood lights near each nozzle; and the flood lights are protected by heavy plate glass and ½-inch mesh screens. The windows are continually washed with water jets on their exposed sides to clear away accumulating sand; but, even so, the forcibly scattered sand "frosts" the glass and makes replacement necessary every four weeks. All window-cleaning nozzles are controlled by a single valve.

The required water pressure is provided by two Cameron pumps—one a No. 4 HMT 4-stage and the other a No. 3 EV 2-stage pump, each driven by a 100-hp. General Electric motor. The pumps, as has already been mentioned, run in series when needful. In that case, the first pump picks up water from a sump and discharges it against a 200-pound head, and the second pump picks up the discharged water at that pressure and raises it to the final pressure of 425 pounds per square inch. The first pump is the 2-stage unit, while the second is the 4-stage unit. Either pump can be used alone; and one pump will serve to provide sufficient pressure for cleaning many of the castings. Whether working singly or in series, the pumps discharge 450 gallons of water per minute.

The largest casting cleaned hydraulically is what is known as "boring-mill bed and housing" complete. Its over-all dimensions are 8x8x12 feet, and it weighs as much as 21 tons when stripped from the molds. The smallest casting cleaned in this manner has over-all dimensions of 2x2x4 feet, and weighs 500 pounds. The latter casting is put in a steel cage that is secured to the turntable. This is necessary to keep a casting of this size in place while undergoing core-washing, because otherwise it would be banged all about the chamber by the force of the attacking streams. The cage used is made of channel iron.

We cannot go into particulars regarding the savings in each type and size of casting, but a few examples will serve to make clear the economies effected. For instance, it used to take three men a whole day—that is, 27 man-hours—to remove the core from a bor-



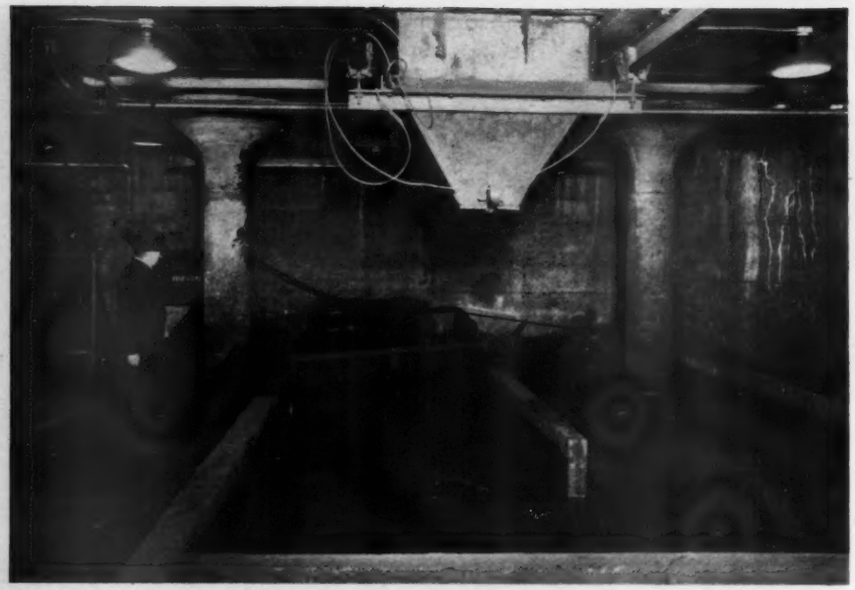
Ladles being heated near one of the cupolas in the foundry of The Bullard Company.

1—Close-up of one of the two Morse swivel-type nozzles through which high-pressure water is directed at the castings. 2—Operator at the control station of the lower of the two Morse nozzles. 3—Looking down into the core-cleaning room through the hatch in the ceiling while one of the nozzles is in action. Note small nozzles for the discharge of jets of water for washing the observation and the lighting windows. 4—A large casting from which the core has been washed, showing the gaggers and arbors used to reinforce the core. 5—Hoisting a cleaned casting out of the hydraulic cleaning room situated below the foundry floor.

ing-mill bed casting with mechanical aids. This can now be disposed of with the hydraulic equipment in 7½ man-hours. The savings are directly proportional to the size of the casting—in other words, the larger the casting the greater the economy. Of course, the design of the casting is a determining factor; and in open castings the cores can be washed out in an incredibly short time. The plant began operating in January, 1929; and in the course of the succeeding twelve months saved the equivalent of one third of its cost!

Some one will comment on the amount of water required and the cost of it, inasmuch as it is obtained from the city system. The used water flows from the cleaning department into a concrete basin just outside, where it is first screened and then filtered through a bed of coke—passing thence to a sump for re-use. By this arrangement the daily replacement of water amounts to only about 100 gallons. Most of the water that is lost is carried off in the sand that is, incidentally, reclaimed by the interposed screen in the water-cleaning basin. On the authority of Mr. Jim Coltman, foundry superintendent, 85 per cent of the sand is recovered for re-use. The sand so treated is a washed sand and free of the binder mixed with it in making the cores. Repeated tests have disclosed that the screening and the filtering remove all but 13 grains of solid matter per gallon of water as redelivered to the pumps. This arrangement, besides insuring savings in the operation of the system, safeguards the pumps from the erosive action of sand that otherwise would be carried to them by the re-used water.

According to one of the officials of The Bullard Company, the substitution of horsepower for manpower has brought about a net gain of approximately 35 per cent in dollars and cents, or substantially $6 per ton on the run of foundry castings. In addition to that, the hydraulic system has done away with a dusty and disagreeable atmosphere for the workers and is producing cleaner castings. While the old miner did not survive to see the perfected installation in service, nevertheless it was his enterprise and his persistence that revealed the possibilities of high-pressure streams of water. The engineering force of The Bullard Company has displayed skill and resourcefulness in making the system a success.



Sand-recovery and water-cleaning tank which makes it possible to reclaim for re-use 85 per cent of the sand washed out of the castings and to clean the water used by the nozzles so that it can be fed back to the pumps with a daily loss of only 100 gallons. The water and sand issue from the cleaning room through the scupper at the left, and the sand is intercepted by the screen while the water flows around a baffle and thence through the coke bed at the right.

The rubber industry consumes 70 per cent of the carbon black produced in the United States.

to the right or to the left into an 800-foot portable conveyor which, in turn, discharges into barges of 100 tons capacity each.

From Mukden comes the news that the Chinese are planning to develop Manchuria on an extensive scale. The first step in this work of industrial expansion is the building of a system of railroads which will interconnect all the principal cities and make the government independent of the lines now operated in the territory by the Japanese. Work on five separate roads, which will have an aggregate length of approximately 1,000 miles, is to be started this year.

LARGE-SCALE HARVESTING OF SALT

THE caterpillar tractor has invaded another field—that of salt harvesting out in California. After seven years of preparation and waiting for Nature sufficiently to evaporate the moisture so as to permit the working of certain saline marshes on Lower San Francisco Bay, the Alviso Salt Company is now engaged in taking its first crop from its 1,500-acre "farm".

The means employed are said to be nothing short of revolutionary; and they enable four men to harvest 65 tons of salt per hour and at a fraction of the cost of the methods heretofore used. Traveling back and forth over the expansive bed of salt, the huge caterpillar, with its special 4-foot-wide treads, breaks up the top layer of the hard white mass by the aid of a rotary digger. The digger has 240 teeth, and its cutting depth is controlled by a pair of air-operated pistons, one at either end of it. The loose salt is scraped up, elevated, and deposited by the same tractor either

How salt is now being harvested out on some of California's marshes. The special caterpillar tractor is capable of digging and delivering salt at the rate of more than 2,000 pounds a minute.

GIANT TURBO-GENERATOR FOR INDUSTRIAL USE

THERE is now in process of construction at the Schenectady plant of the General Electric Company a vertical, compound turbo-generator that is to have a capacity of 110,000 kw. The turbine is being built for the Ford Motor Company, and will occupy just about the same floor space as did the two older units which it is to replace while producing more than four times as much power. It will be 57 feet long, 23 feet wide, 21 feet high, and weigh approximately 1,000 tons.

To provide cooling water for this giant turbo-generator, the plant is being connected with the Detroit River by a tunnel 15 feet in diameter and nearly 2½ miles long. This tunnel will deliver 750,000,000 gallons of water every 24 hours and at a rate of flow of 14 feet a second. The unit represents the latest improvements in the art; and is said to be the first of its kind to use steam at 1,200 pounds pressure.

Airplane view of the expansive plant of the West Coast Wood Preserving Company on Bainbridge Island near Seattle, Wash.

Modern Timber-Creosoting Plant Calls for Use of Much Compressed Air

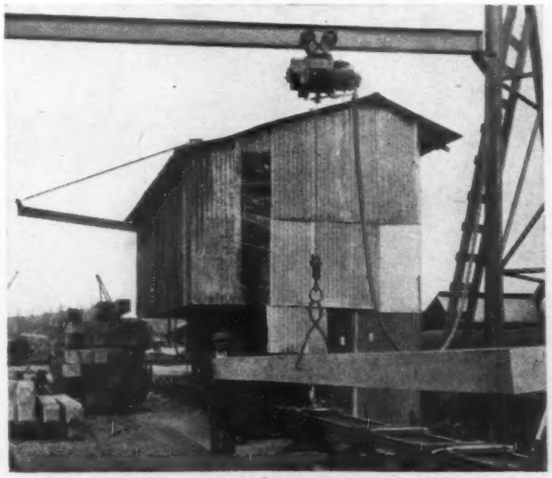
The West Coast Wood Preserving Company, of Seattle, Wash., Has One of the Best-Equipped Plants of the Kind in the United States

By C. W. BUCKLEW

WITHIN thirty minutes by steamer from Seattle's waterfront, at Eagle Harbor on Bainbridge Island, there is located the plant of the West Coast Wood Preserving Company, which is one of the largest and most modern pressure-creosoting establishments in the United States. This plant was entirely rebuilt during 1927, and until its merger with the J. M. Colman Company, in February last, was operated under the name of the Pacific Creosoting Company. As originally organized, the concern was called the Perfection Pile Preserving Company; and, in its early days, processed fir piling for marine use by wrapping them in burlap held in place with wire and dipping them in tar. About 1908, the process was changed—creosoting was introduced, and that method of treatment has been practiced there ever since.

The plant and the storage yard together cover some 25 acres of ground in addition to the large booming space in the adjoining bay. The dock is built into deep water, permitting ocean-going vessels and tankers to load and to discharge directly onto the company's property. Railroad facilities are also available in the form of a car-barge service.

There are six treating retorts, each 7½ feet in diameter and 132 feet long, made of ⅞-inch gage steel. They are butt-jointed both circumferentially and longitudinally; and the inside rivet heads are flattened so as to give as smooth an inner surface as practicable. The retorts are equipped with vapor drums, a condenser, and two drip tanks, and are capable of treating timber either by the full-cell or the empty-cell process.

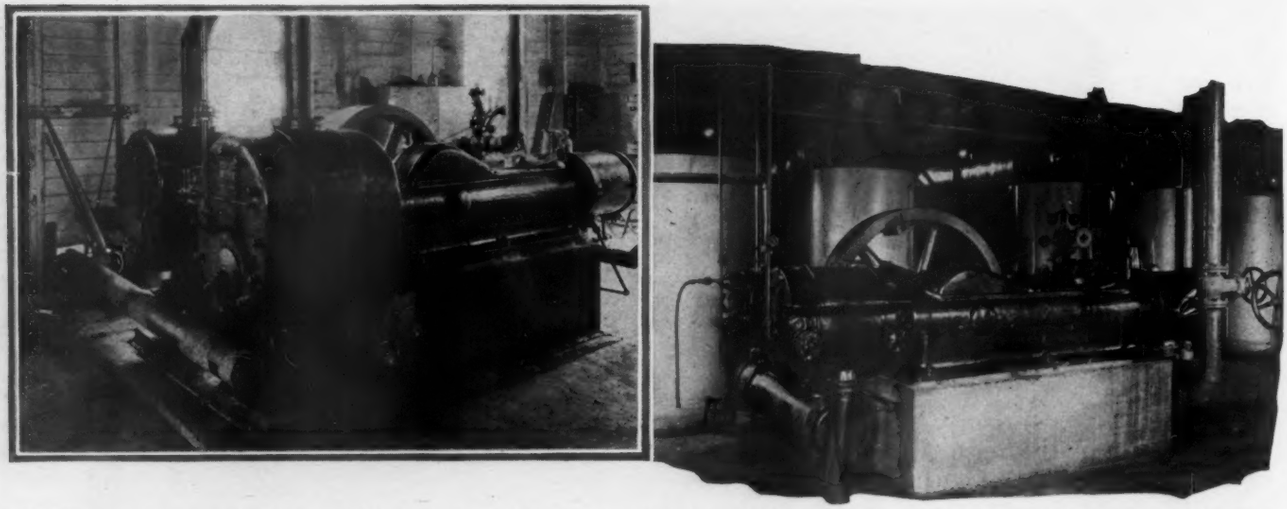


Size "C" air-motor hoists have proved extremely useful in handling timber at various points about the plant.

The boiler plant consists of two 306-hp. Sterling type water-tube boilers with automatic feed-water and damper control. Hogged sawmill waste is burned under these boilers. This fuel is brought to the plant on barges and moved by belt and chain conveyors into a storage bin from which it is fed to Dutch ovens by chain conveyor.

In the retort room are two Ingersoll-Rand vacuum pumps—one Imperial Type 20x12-inch X-4 and one Type FR-1. These are used to produce the vacuum required in the treating process. An Imperial Type X-3 Ingersoll-Rand compressor, with a capacity of about 800 cubic feet of free air per minute, provides air for the Rüpping process, for moving oil, and for operating the pneumatic tools and the air-motor lifts used around the plant.

Two of the retorts are devoted ex-



Left—The vacuum required at certain stages in the timber-treating retorts is produced by this Type X-4 vacuum pump built by the Ingersoll-Rand Company. Right—Compressed air for the timber-treating process and for operating pneumatic equipment about the plant is provided by this Type X-3 compressor.

clusively to the treatment of railroad ties with a creosote-petroleum mixture. A No. 6 NFV Cameron horizontal, turbine-driven, centrifugal pump is used in connection with these two retorts to handle the solution. The condensers are cooled with salt water which is circulated by a No. 6 HV Cameron centrifugal salt-water pump that also provides fire protection for the entire plant. This pump is electrically driven. The condensers have recently been equipped with automatic temperature-control apparatus, resulting in increased efficiency. Cameron simplex pressure pumps serve to force the preservative into the timber.

In addition to the foregoing equipment needed in connection with the operation of the retorts, there are in service about the plant numerous other machines. Among these is a Type 20 auxiliary compressor that supplies air for operating the control instruments, the various pneumatic tools—such as BBW boring machines which are required for different purposes, and the air lifts which are used for handling large timbers around the modern timber-framing mill. In the strictly up-to-date experimental plant is an Ingersoll-Rand Type 15 electrically driven compressor. The tram cars in service are 1-piece steel castings equipped with Timken roller bearings to eliminate friction losses. Two types of trams are in use, one for ties and the other for poles, piling, and other long timbers.

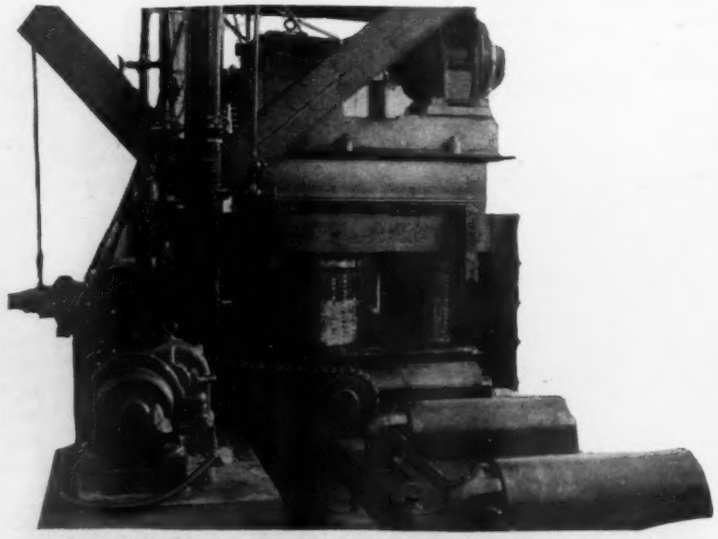
In the construction of the plant, arc and oxy-acetylene welding were used to a large extent both in pipe fitting and in the retorts proper. The retort joints were first riveted and then arc welded. This was done to insure the necessary tightness, which it was impossible to obtain in the old plant where threaded connections prevailed. Cutting, fitting, riveting, and welding displaced at least 85 per cent of the standard fittings and threaded connections ordinarily found in piping, whether it be oil, air, water, or steam piping. The work has been uniformly tight and, therefore, satisfactory.

Besides the treating plant proper there is a tie-framing mill containing Greenlee machines for adzing, boring, and incising. A planing mill is available for manufacturing wood blocks for factory use as well as for trimming and framing other lumber when necessary. There has recently been installed a complete framing mill in order to meet present-day demands for timber framed before treatment.

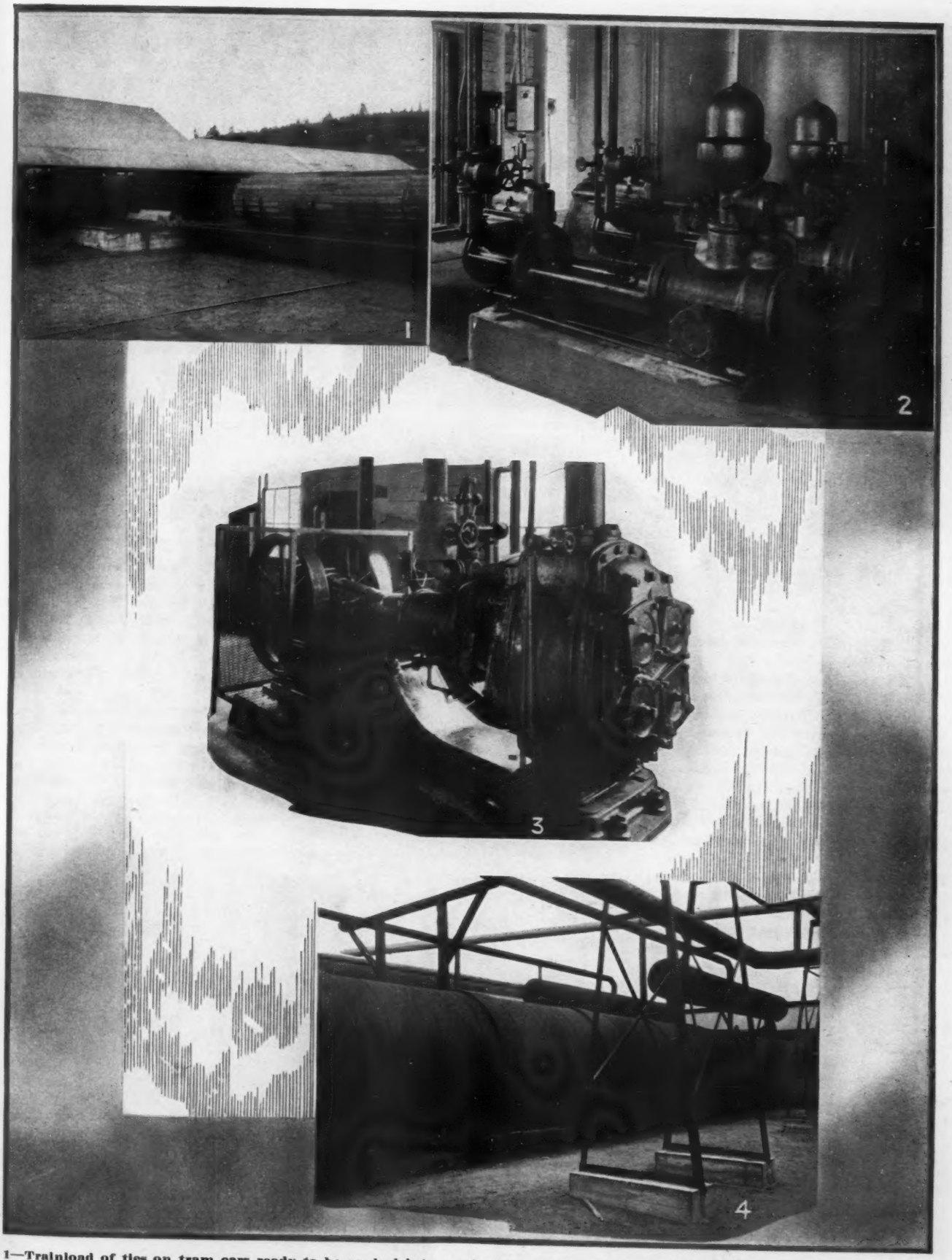
All these separate improvements which have been made from time to time have materially reduced the cost of plant operations and have made for greater efficiency and a better product. At the Bainbridge Island plant are treated piling for marine use, timbers and piling for railroad and highway bridges, Douglas Fir poles, wood blocks for industrial purposes, crossarms, conduits, wood-pipe staves, etc. The economy resulting from the use of pressure-creosoted timber has become generally recognized within the past few years, and the outcome of this recognition is a steadily growing demand for creosoted material. Treating processes are being continually improved, and the plant being considered has kept abreast of the state of the art by adding new equipment and new methods as they have been developed.

A treatment cycle for railroad ties, using the creosote-petroleum mix, is about as follows, although this cycle will vary with conditions and the results desired. On an average, 3,500 cubic feet of ties are placed in one 132-foot retort. After the doors have been closed and the vacuum started, the retort is filled to the proper level with the preservative. This takes something like fifteen minutes. Coincident with the admission of the oil, steam is turned into the heating coils in the retort—the temperature being brought up to and maintained at the desired point for a suitable length of time to properly season the ties. A vacuum of approximately 22 inches is carried during the seasoning period.

When the seasoning is finished, the retort is completely filled with the oil mix and sealed by closing the valves in all outlet connections between the retort and the vapor drums, thus shutting off the vacuum. The simplex pressure pumps, each with a capacity of 103 gallons per minute, are now started and build up a pressure of from 90 to 140 pounds. This is known as hydraulic pressure, and is carried for a suitable interval, perhaps for an hour or more. When the hydraulic pressure is turned off, all the oil is drained from the retort by the No. 6 NFV centrifugal pump. This operation usually takes about fifteen minutes. With this done, compressed air at



This incising machine was designed and built at the plant of the West Coast Wood Preserving Company.



1—Trainload of ties on tram cars ready to be pushed into a retort for treatment. 2—These Cameron simplex steam pumps handle the preservative that is forced into the timber when undergoing treatment in the retorts. 3—Vacuum is produced in the retorts at times for the treatment of railroad ties by this FR-1 steam-driven vacuum pump. 4—Section of one of the great cylindrical retorts, each of which is 7½ feet in diameter and 132 feet in length.

An interesting general view of the timber-treating section of the plant. A group of the retorts can be seen in the middle distance at the right.

120 to 140 pounds pressure is admitted and maintained for from one to two hours. This ends the treatment, and the compressed air is released—something like seventeen hours being required to complete the cycle of operations. For the purpose of incising the ties so as to permit of a more satisfactory penetration of the mix, there has been developed at the plant by company officials an incising machine. This machine is very rugged and does its work effectively.

The Bainbridge Island plant of the West Coast Wood Preserving Company is under the management of H. E. Horrocks, assisted by J. E. Book, superintendent; Del Bertrand, chief engineer; and R. F. Dreitzler, chemist—all men thoroughly familiar with wood-preserving processes. It is due to their ingenuity and farsightedness that the business has grown to its present large proportions and that its products enjoy the high reputation that they do.

And now for a few facts regarding creosoted ties and what they mean to the railroads of the United States. According to C. C. Cook, maintenance engineer of the Baltimore & Ohio, "The railroads of the country, through the present practice of using chemically treated timber for crossties and other purposes, save $145,000 a day. Since 1909, the consumption of treated wood in this country has increased from 75,000,000 to 336,000,000 cubic feet. The railroads consume three-fourths of this quantity at the present time, largely for ties. The life of chemically treated ties is frequently treble that of untreated ties." Mr. Cook has predicted that the average life of ties will soon be more than twenty years, and when this comes to pass, he states, the railroads will save $287,000 a day.

The American Automobile Association has estimated that the 1930 expenditures for highway and street construction in the United States will exceed $2,500,000,000 and furnish employment to 625,000 people.

PNEUMATIC CLAMP ASSISTS IN WELDING OPERATION

THE accompanying illustration is just another example of the many air-operated devices that are continually being improvised in this or that plant to meet special services. In this case we have a pneumatic clamp that is effectually doing the work for which it was conceived at the Transcona locomotive shops of the Canadian National Railways.

In welding steel hub liners to locomotive driving-wheel centers it is necessary that the liners be held firmly in place, and that is what the air-operated clamp is designed to do. It consists of a 2-pronged fork to span the space to be filled and welded and of a pneumatic holder-on with a heavy pipe extension that serves as a brace against the opposite wheel. The clamp can be shifted quickly from point to point, and greatly facilitates the work of the welder. For his convenience, and to enable him to do a better job, the driving wheels are stood on end while welding is in progress.

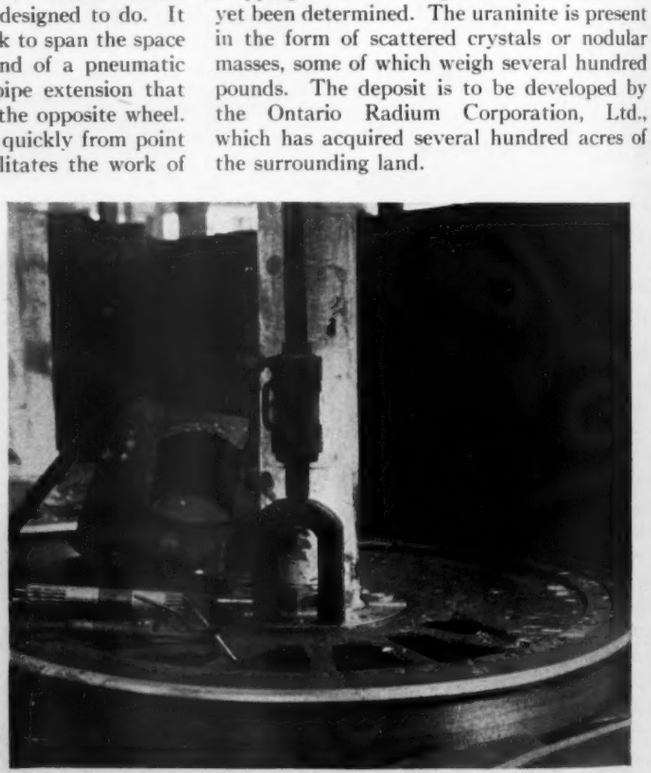
Germany, that leads the world in the use of lignite for the production of power for municipal and industrial consumption, is now experimenting with an even lower-grade fuel, with peat, which is lignite in the making. This material, of which there is an abundance available especially in East Prussia, has been coked, made into briquettes, and burned with results, so it is reported, not unlike those obtained with lignite.

CHEMISTS FIND NEW USE FOR THE CORNSTALK

A SUBSTANCE something like hard rubber in appearance and properties has recently been developed from cornstalks by the United States Bureau of Standards in cooperation with the Iowa State College. These organizations have set themselves the task of finding industrial uses for this agricultural by-product, of which such an abundance is annually available in this country; and the present product, which has been named "Maizolith", is the result of earlier investigations with cornstalks that had to do with the making of paper pulp.

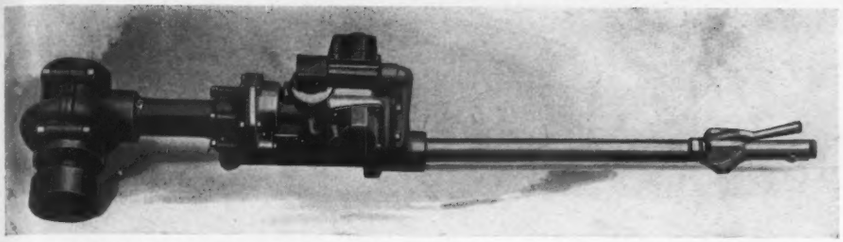
It was recognized during those investigations that it was extremely difficult to overcome the inherent tendency of the material to hydrate, and this characteristic has been taken advantage of in the case of the substance under consideration. It has been found easy by severe chemical and mechanical treatment to completely hydrate the stalk so as to form a jellylike mass containing no trace of fibrous structure. This jelly is dried, and in that condition lends itself readily to machining. The belief prevails that cornstalks may thus eventually be used in the manufacture of insulating material, noiseless gears, and the like.

Radium ore in workable quantities has been discovered in Canada—the first find of the kind in the Dominion. The uraninite-bearing vein is in Haliburton County, Ont., and, according to the Federal Department of Mines, has been uncovered for a length of 150 feet and traced 400 feet farther by the aid of outcroppings. Its full length, however, has not yet been determined. The uraninite is present in the form of scattered crystals or nodular masses, some of which weigh several hundred pounds. The deposit is to be developed by the Ontario Radium Corporation, Ltd., which has acquired several hundred acres of the surrounding land.



Courtesy, Railway Mechanical Engineer

The pneumatic clamp used at the Transcona shops of the Canadian National to hold hub liners in place during welding.



The DEA pneumatic wrench that will tighten or remove with dispatch flexible staybolt caps or nuts on bolts up to 1¼ inches in diameter.

METAL SLEEPERS FOR GERMAN STATE-OWNED RAILWAYS

UNDER a new construction program, the German State Railways are substituting steel for wooden ties at the rate of about 500 miles a year. This step is the outcome of exhaustive experiments with metal sleepers which, generally, have been frowned upon because increased noise and vibration seemed to be associated with them. However, it is reported that as the result of a new type of rail, now adopted as standard in Germany, the vibration has been reduced to such an extent that it does not exceed by more than 3 per cent that of wooden ties. There is little difference between the two kinds of sleepers in the matter of noise.

Only within tunnels, along coast lines, and wherever else the atmosphere is moisture laden, are wooden ties to be retained. This means that about three-fourths of the state-owned lines, or approximately 23,000 miles, are affected by the change. In industrial regions, the sleepers will consist of metal containing from 0.2 to 0.25 per cent of copper.

ELECTROLYTIC PROCESS FOR COPPER-SULPHIDE ORES

FOLLOWING research work over a period of a year and more, the School of Mines and Geology of the State College of Washington has announced the discovery of an electrolytic process for the recovery of practically pure copper from copper-sulphide ores.

According to Dean A. E. Drucker, head of the mining school, "We have at last solved the various problems and are able under the right conditions to get a very pure cathode copper. The small mine operator, with the proper conditions at hand, can treat his own ore in the mine from beginning to end, produce pure electrolytic copper of marketable value, and eliminate the deductions in extractions and the various penalties usually charged against the shipper when ore is sold outright to the smelter. I think it is safe to say that we are the first to make such electrolytic investigations, and that this is the future metallurgy for copper-sulphide ores."

Evidently, the small producer will be the one to be most benefited by the new process, which will depend on cheap hydro-electric power to make it generally practicable.

Canned foodstuffs to the value of $600,000,000 and more are now produced annually in the United States.

IMPROVED PNEUMATIC WRENCH DOES FAST WORK

AN improved pneumatic wrench, designated the DEA, has been produced and put on the market by the Ingersoll-Rand Company of New York City. This wrench is said to fill the long-felt want for a light-weight, powerful machine that will tighten or remove nuts on bolts up to 1¼ inches in diameter and do other similar work. It weighs 33 pounds; and when operated with air at 90 pounds pressure has an average working speed of 75 revolutions per minute.

A 3-cylinder type of air motor is used to drive the wrench. Each of the cylinders, which are interchangeable, is held in place by four cap screws and, being separate from the case, can be readily renewed if necessary. The three pistons act through connecting rods upon one crankpin—the operation being so timed as to insure a steady torque. Vibration is reduced to a minimum by accurately balanced rotating parts. Although the motor, is non-reversible, the wrench is reversible by means of a double-ended spindle, to either end of which may be attached different-sized chucks for right- or left-hand work.

The chucks are a snap fit on an adapter which, in turn, is a snap fit in the spindle. This makes for quick and easy replacement when a chuck of another size is required or when it is necessary to reverse the motion of the tool. Chucks of varying sizes are provided for hexagon and square nuts and for cap screw heads.

On work such as removing or applying flexible staybolt caps, nuts on cylinder and valve chamber heads, dome nuts, front end nuts, etc., the new air-driven wrench will save time and money and lighten the operator's labors, says the manufacturer. This is vouched for by one of the leading railroads in the United States which reports that the DEA has made it possible to remove a complete installation of 600 flexible staybolt caps from a certain type of locomotive boiler in three hours and 750 caps from a boiler of another type in 3¾ hours. This road claims that the machine paid for itself on the first seven boilers.

TRYING TO MAKE A BUILDING BONE DRY

WHEN the new Outpatient Clinic of the John Sealy Hospital in Galveston, Tex., is completed, it will probably be the most waterproofed structure in existence. Galveston is situated on a low, sandy island between the Gulf of Mexico and Galveston Bay, and is very damp in consequence. Dry basements are almost unknown there, and many buildings are obliged to run pumps continually to hold the water at bay. Besides, there is much moisture in the air, and drenching semi-tropical rains add to the difficulty of keeping houses dry. Therefore, when planning the annex to the hospital, every conceivable precautionary measure was taken to make the foundation, the walls, and the roof proof against water and dampness.

A formidable array of materials and compounds—including membrane waterproofing, marine cement, damp-resisting paint, plastic waterproofing, and a dehydration solution—is being utilized in one way or another throughout the entire structure to bring about the desired result. The membrane waterproofing, consisting of several layers of asphalt-saturated-and-coated felt has been employed generously from the foundation on up to the first floor. But before this was applied by hand, the surfaces so protected were first covered with a cold binder sprayed on with air under pressure. In fact, the air-operated spray is doing much to facilitate the work.

Wherever the special paint is required, it is put on by the air brush; and the same handy apparatus is being used to coat with a tar compound the underside of all concrete beams, slabs, joists, girders, etc., on the ground floor. Likewise, it is speeding up the job of covering the masonry walls of the building both inside and outside with the dehydration solution. The outer walls are to be gone over twice with this transparent fluid in order to effectually seal the pores of the stone and the brickwork and thus to prevent moisture from penetrating. The outcome of this departure in building methods is being awaited with interest; and, if it is a success, should prove a boon not only to Galveston but to other places similarly situated.

Flexible staybolt caps being removed with the new wrench in less time than heretofore possible.

NEW WAY OF HANDLING SLAG FOR ROADBUILDING

THE piles of blast-furnace slag that have in the past presented more or less of a problem to iron producers may become a thing of the past if it be possible, as we are told it is, to convert the still molten slag directly into roadbuilding material, for which it is utilized nowadays. Dumping and subsequent reworking of the slag, and the cost incident thereto, would thus be eliminated.

By a new process, reports *The Engineer*, slag from basic blast furnaces is run into ladles which take it to pans, alongside the furnaces, where it is cast into large cakes about 15 inches thick. While cooling, the slag anneals itself—the resulting product being almost as hard as granite and impervious to water. When cool, the slabs are broken, crushed, screened, and graded ready for delivery to the user. In this way a material possessing uniform properties can be furnished.

NEW REFRACTORY MATERIAL

A NEW refractory material suitable for boiler baffles and lining furnace doors has recently been tested at the Mellon Institute of Industrial Research under the direction of Stuart M. Phelps. This refractory is obtained by mixing "Lumnite", a building cement, with "Plibrico", a high-temperature cement. In reporting on the tests, the Institute says, in part:

"With mixtures of the two materials it was shown that as the percentage of Lumnite was increased the pyrometric cone equivalent was lowered but the mechanical strength increased up to the fusing point of the mixture. Tests made on 4-inch cubes with one face exposed to heat revealed satisfactory strength under load up to a temperature of 2,500 °F. In other words, the higher the percentage of Lumnite the stronger the cube at low temperatures. As the temperature increases, however, the straight Plibrico reaches the same strength as the mixture and is, of course, more refractory."

MORE WATER FOR BOSTON

BOSTON is engaged on a big construction job that will add by 1944—the estimated date of completion—214,000,000 gallons of water a day to the city's present supply. This gives some idea of the magnitude of the project, which embraces the diversion of the waters of the Ware and the Swift rivers so that they will ultimately flow into Boston's reservoirs.

The first half of the work is now well in hand, and includes the sinking of eight shafts and the driving of about thirteen miles of tunnel having a horseshoe-shaped cross section and a maximum width of about 12 feet. This aqueduct will link the Ware River with the Wachusett reservoir. It will tap the stream at a point near the Village of Coldbrook, where a diversion dam is to be built.

HANDBOOK OF CHEMISTRY AND PHYSICS, by Charles D. Hodgman, M.S., and Norbert A. Lange, Ph.D. A volume of 1,389 pages, published by Chemical Rubber Publishing Company, Cleveland, Ohio. Price, $5.00.

THIS volume is the fourteenth edition of the work, and is compiled from the most recent authoritative sources. The aim has been to present in a condensed form as much accurate and up-to-date information in the fields of chemistry and physics as could be brought together in a form that would be convenient for wide distribution and use. Chemistry and physics have been brought into still closer relations through developments due to recent research; and because of this the student of either science should have a fuller knowledge of the other and associate science. The purpose has been, therefore, to provide a handbook that would be useful to each and to both.

SCIENCE AND THE NEW CIVILIZATION, by Robert A. Millikan. A book of 194 pages, published by Charles Scribner's Sons, New York City. Price, $2.00.

DOCTOR Millikan holds too conspicuous a position in the scientific world to require an introduction, and probably there are but few of us unaware that he it was who discovered the "cosmic rays". The present book is really an aggregation of addresses and articles which the author has made and written at various times in the course of the last few years. All are couched in language readily grasped by the so-called average person; and their purpose is to broaden general understanding of the aims and the attitude of science, and to make known the part science has played in the past, is playing now, and may reasonably be expected to play as the human race goes triumphantly forward.

Doctor Millikan points out that the astonishing discoveries of the last half-hundred years have "relieved mankind forever from the worst of the physical bondage with which all past civilizations have enchained him". In other words, machinery has helped man tremendously. And to the question: "What will man do with the new leisure that is his?" Doctor Millikan answers with optimistic reassurance. This book makes easy and fascinating reading, and deals with topics about which the majority of us can learn to our advantage.

MINERAL RESOURCES OF THE UNITED STATES, 1926. A 2-volume work, of 1,449 pages, prepared by the United States Bureau of Mines and purchasable from the Superintendent of Documents, Washington, D. C. Price, $1.25.

ONE needs a work of this nature to make it clear to him how extensive and varied in character is the mineral wealth of the United States. It should be pointed out that the importance of our mineral industries to the modern world and the extraordinary dependence of our economic civilization upon them are not indicated by their physical volume nor by their money value. A better appreciation grows from a realization that the mineral raw materials of domestic origin constitute more than half of the freight handled by the railroads of the country, while those raw materials combined with products thereof in the first stages of manufacture make up more than two-thirds of the freight transported by our railroads. Furthermore, our supplies of energy, so vital to our high standard of living and to our industrial supremacy, are to the extent of 90 per cent derived from mineral fuels.

Volume I is devoted to the metals mined by us, while Volume II deals with non-metallic minerals found within our boundaries. The two volumes serve to provide not only statistical data but much information upon the many different uses to which our minerals are put.

THE ART OF RAPID READING, by Walter B. Pitkin, Professor in Journalism, Columbia University. A book of 233 pages, published by McGraw-Hill Book Company, Inc., New York City. Price, $2.50.

THE purpose of this book is to aid people that wish to read with better results. As the title plainly indicates, the author has set himself the task of pointing the way and of furnishing the means by which the average person can sharpen his powers of perception and thus read understandingly and quickly so as to keep effective pace with the hastening tide of current events and general knowledge.

Professor Pitkin applies modern psychological methods in order to bring about the desired result. His book is filled with fascinating information about the eye and the mind and the manner in which they collaborate; and he explains how both can be used more efficiently than is commonly the case. The tests and exercises provided make the book well worth while; and these serve both to entertain and, at the same time, to make it possible for one to appraise his mental and his optical agility.

Diamond Core Drilling in Oil Field Practice is the title of a brochure issued by R. S. Patrick, Duluth, Minn. Persons intending to purchase and to use diamond core drills will find the publication helpful.

The Labors of a Modern Hercules is an illustrated brochure published by the Hercules Powder Company, Wilmington, Del., and can be had gratis upon request. The booklet contains a number of well-written and interesting articles.